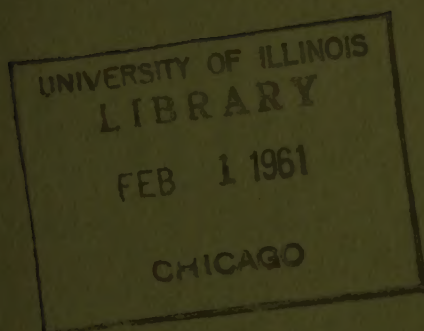


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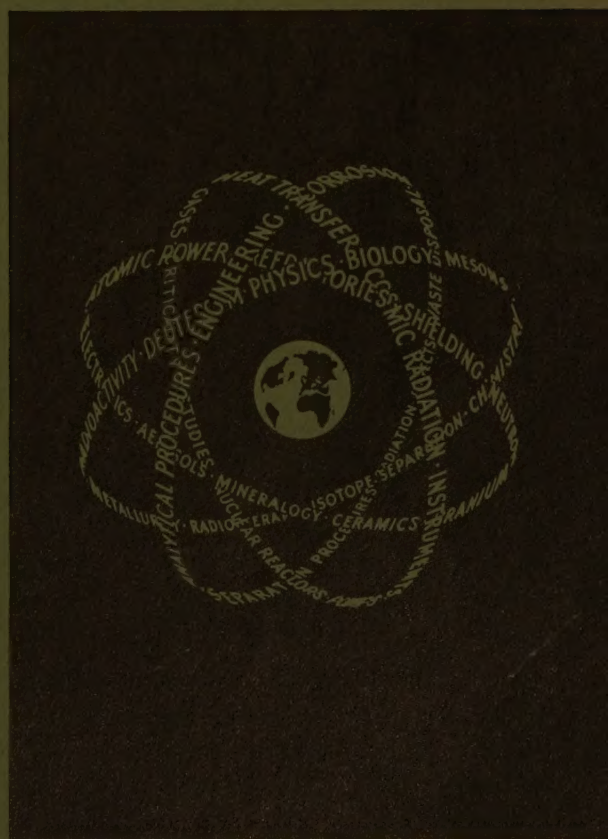
NUCLEAR SCIENCE ABSTRACTS



December 31, 1960

Volume 14 Number 24A

Abstracts 25110 - 26514



UNITED STATES ATOMIC ENERGY COMMISSION

Office of Technical Information

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NUCLEAR SCIENCE ABSTRACTS

Volume 14 Number 24A

December 31, 1960

GENERAL AND MISCELLANEOUS

25110 HMI-B12

Hahn-Meitner-Instituts für Kernforschung Berlin.
DRITTER JAHRESBERICHT 1959. (Third Yearly Report
(1959)). June 1960. 69p.

The annual report of the Hahn-Meitner-Instituts für Kernforschung, Berlin, is presented. In the nuclear-chemistry section, reports are given on institute operations, reactor operations, scientific activity, and administrative matters. Personnel, buildings, organization, and reports of the Mathematics Division are surveyed. (T.R.H.)

25111 ORNL-2983

Oak Ridge National Lab., Tenn.
CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR
PERIOD ENDING JUNE 20, 1960. Sept. 22, 1960. 97p.
Contract W-7405-eng-26. OTS.

Progress made in nuclear chemistry, isolation and chemical properties of synthetic elements, chemical separation of isotopes, radiation chemistry, organic chemistry, chemistry of aqueous systems, chemistry of corrosion, nonaqueous systems at high temperature, and chemical physics is reported. Separate abstracts have been prepared for each section. (W.L.H.)

25112 ORNL-2993

Oak Ridge National Lab., Tenn.
CHEMICAL TECHNOLOGY DIVISION ANNUAL PROGRESS
REPORT FOR PERIOD ENDING AUGUST 31, 1960.
Sept. 26, 1960. 255p. Contract W-7405-eng-26. OTS.

Progress is reported on Head-End and Solvent Extraction Processing, Power Reactor Fuel Processing Pilot Plant, Fused Salt-Fluoride Volatility Process, Molten Salt Reactor Fuel Processing, Homogeneous Reactor Fuel Processing, Waste Treatment and Disposal, Fuel Cycle Development, Amex Process, Thorium Recovery from Granitic Rocks, Gas Cooled Reactor Coolant and Equipment Decontamination, HRP Thoria Blanket Development, Surface Chemistry, Transuranium Studies, Fission Product Recovery, Solvent Extraction Technology, Extraction Reagent Performance, Radiation Effects on Catalysts, Ion Exchange Technology, Chemical Engineering Research, Chemical Applications of Nuclear Explosions, Oxygen-17 Separation Pilot Plant, Reactor Evaluation Studies, and Eurochemic Assistance Program. Separate abstracts have been prepared for the preceding sections. (W.L.H.)

25113 TID-4552(2nd Rev.)

Office of Technical Information Extension, AEC.
SUBJECT SCOPE AND LITERATURE COVERAGE OF NUCLEAR SCIENCE ABSTRACTS. Sept. 1960. 61p.

A guide is presented in which the scientific and technical subject matter included in NSA is described along with the

literature which is reviewed for abstracting in this publication. Subject categories and periodicals scanned for NSA are listed. (J.R.D.)

25114 UCRL-6030-T

California. Univ., Livermore. Lawrence Radiation Lab.
APPLICATION OF NUCLEAR EXPLOSIONS AS SEISMIC
SOURCES. Gerald W. Johnson. July 7, 1960. 52p. OTS.

Presented at the meeting of the International Union of Geodesy and Geophysics, held in Helsinki, Finland, July 25–August 6, 1960.

The use of large chemical and nuclear explosions as seismic sources for determining important geophysical characteristics of the earth and the properties of seismic waves is considered. The nuclear experience and its interpretation are summarized with a description of methods of stemming the explosion to assure containment of radioactivity. Included are estimated typical costs that might be incurred in the United States to provide seismic sources under various circumstances. The underground nuclear explosions set off at the Nevada Test Site are listed with dates and times of firing and the coordinates of the centers of detonation. (W.L.H.)

25115

FRACTIONATION OF NUCLEAR WEAPON DEBRIS.
C. Sharp Cook, R. L. Mather, R. F. Johnson, and F. M. Tomnovec (U. S. Naval Radiological Defense Lab., San Francisco). Nature 187, 1100-1(1960) Sept. 24.

At the time of one of the nuclear detonations at the Pacific Proving Grounds, gummed paper fall-out collectors were used to collect particles for radiation analysis. Gamma radiation from the individual particles collected fell into two groups, one rich in Zr^{90} and Nb^{90} radiations and the other essentially depleted of these radiations. A gamma ray at about 500 kev, presumably Ru^{103} appeared in both spectra but was in much larger relative amounts in the sample depleted of Zr^{90} and Nb^{90} . (M.C.G.)

25116

TRANSACTIONS OF THE AMERICAN NUCLEAR SOCIETY,
SAN FRANCISCO, DECEMBER 11-15, 1960. Frank Ward,
ed. Trans. Am. Nuclear Soc. 3, No. 2 (1960).

Summaries are given of the 352 papers presented at the December meeting. Sessions were held on critical experiments, computer codes and numerical analysis, nuclear engineering education, shielding, radiation chemistry, fuel reprocessing and waste handling, reactor resonance physics, reactor mathematics, fuel element engineering, nuclear rockets, hot cells and laboratories, reactor theory and fuel cycles, reactor engineering, analysis, subcritical and reactivity experiments, safeguards, reactor dynamics, metallurgy and fuel manufacturing, isotope applications, instrumentation, neutron physics, heat transfer and fluid

flow, manipulators and viewing, neutron thermalization and spectra, reactor physics analysis, reactor operations, theoretical physics, chemistry of nuclear reactor systems, experimental physics, radiation effects, waste management and disposal, remote reactors and reactor concepts, and glovebox and specialized equipment design. Subject and author indexes for both Vol. 3, No. 1, and Vol. 3, No. 2, are included. (W.D.M.)

25117

MODERN NUCLEAR TECHNOLOGY: A SURVEY FOR INDUSTRY AND BUSINESS. Mark M. Mills, Arthur T. Blehl, and Robert Mainhardt, eds. New York, McGraw-Hill Book Company, Inc., 1960. 344p. \$9.50.

The material contained is, for the most part, the result of a series of lectures given under the Engineering Extension Program of the University of California in Berkeley during the summers of 1956 and 1957. The purpose of the lectures was to present the fundamentals of nuclear engineering on a level which would help management to understand some of its problems. No lectures were given on basic engineering principles or methods of approach. Accordingly, many of the lectures are unsophisticated for the nuclear expert or the engineer actively engaged in reactor design or operation. A glossary of the "new nuclear engineering vocabulary" is included, and every effort is made throughout to use the words in their proper context. (B.O.G.)

25118

Texas. Agricultural and Mechanical Coll., College Station. Engineering Experiment Station.

PROCEEDINGS OF THE SECOND ANNUAL TEXAS CONFERENCE ON THE UTILIZATION OF ATOMIC ENERGY, HELD AT THE A. & M. COLLEGE OF TEXAS, NOVEMBER 12, 13, 1959. A Miscellaneous Publication of the Texas Engineering Experiment Station, April 1960. E 72-60. 1960. 70p.

Fourteen papers were presented at the conference. Separate abstracts have been prepared for each paper. (W.L.H.)

BIOLOGY AND MEDICINE

General and Miscellaneous

25119 A/AC.82/G/L.396

Institute of Public Health. Radiation Health Lab., Tokyo and Gunma Univ., Kiryu, Japan. Kiryu Coll. of Technology.

THE CONCENTRATION OF CESIUM-137 IN HUMAN TISSUES AND ORGANS. Noboru Yamagata and Toshiko Yamagata. May 1960. 24p.

Analytical results are given from a study of Cs^{137} in tissues and organs from 18 autopsies of instantaneous death in Tokyo, August 1958 to July 1959. The normal existence of Cs^{137} in rib bones is briefly discussed. (T.R.H.)

25120 CEA-1534

France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay.

ORGANISATION DES RECHERCHES BIOLOGIQUES MENEES AUX ETATS-UNIS PAR L'ATOMIC ENERGY COMMISSION OU SOUS SON EGIDE. (Organization of Biological Research Carried out in the United States by the A. E. C. or Under its Contract). J. Pellerin. 1960. 84p.

The general organization of the USAEC Division of Biology and Medicine is described. The research activi-

ties carried on in national and contractor laboratories are discussed. The systems of collaboration set up with external research organizations in the form of research contracts are examined. (C.J.G.)

25121 LAMS-2445

Los Alamos Scientific Lab., N. Mex.

BIOLOGICAL AND MEDICAL RESEARCH GROUP (H-4) OF THE HEALTH DIVISION SEMIANNUAL REPORT [FOR] JULY THROUGH DECEMBER 1959. Feb. 1960. 408p. Contract W-7405-eng-36. OTS.

Separate abstracts were prepared on 44 sections of this report. A list of manuscripts submitted and accepted for publication during the period is included. (C.H.)

25122 LAMS-2445(p.27-36)

Los Alamos Scientific Lab., N. Mex.

NUCLEAR PHOSPHORYLATION IN HEMATOPOIETIC TISSUES. D. F. Petersen and L. B. Cole.

Results are summarized from tracer experiments designed to assess the nuclear-cytoplasmic interactions affecting nucleotide polyphosphate concentrations in the spleen and thymus of rats during the early postirradiation period. Results are tabulated and discussed. (C.H.)

25123 LAMS-2445(p.46-9)

Los Alamos Scientific Lab., N. Mex.

THE EFFECT OF MER-29 ON THIOPENTAL SLEEP TIME. D. F. Petersen, R. G. Gould, and E. H. Lilly.

MER-29 (1-[p(β -diethylaminoethoxy)phenyl]-1-(p-tolyl)-2-(p-chlorophenyl)ethanol) markedly decreases cholesterol biosynthesis by inhibiting the reduction of the side chain double bond of 24-dehydrocholesterol. Levels of MER-29 which effected a pronounced decrease in plasma cholesterol and weight gain due to anorexia failed to alter significantly the duration of thiopental anesthesia in mice. It was concluded that short-term chronic feeding of MER-29 does not cause alterations in hepatic function as measured by this test. (C.H.)

25124 LAMS-2445(p.54-8)

Los Alamos Scientific Lab., N. Mex.

THE METABOLISM OF DIETHYLENETRIAMINE PENTAACETIC ACID (DTPA). H. Foreman and M. Magee.

The metabolism of diethylenetriamine pentaacetic acid (DTPA) was investigated. C^{14} was used as a label for the compound and the tissue distribution was determined at various times after oral, intramuscular, intravenous, and intraperitoneal administration to rats. Data are tabulated. (C.H.)

25125 LAMS-2445(p.59-63)

Los Alamos Scientific Lab., N. Mex.

THE EFFECT OF DIETHYLENETRIAMINE PENTAACETIC ACID (DTPA) ON ACCELERATION OF PLUTONIUM EXCRETION. H. Foreman, M. B. Roberts, and M. Magee.

Am^{241} was used as a model for plutonium as Am behaves very similarly to plutonium in the body and Am^{241} is a gamma emitter which can be used to measure residual activity in the intact animal. The effect of diethylenetriamine pentaacetic acid on the excretion of Am^{241} by rats was studied after oral and parenteral administration. Data are presented graphically. Results indicate that less frequent administration of the drug at late time periods is as effective as daily administration in hastening the excretion of the chelated metal. (C.H.)

25126 LAMS-2445(p.80-9)

Los Alamos Scientific Lab., N. Mex.

METABOLISM OF ZINC⁶⁵ IN MAMMALS. C. R. Richmond, J. E. Furchner, and G. A. Trafton.

The absorption, excretion, and retention of Zn^{65} were studied in mice, rats, dogs, and man by whole-body radio-

assay techniques. Data are tabulated and presented graphically. (C.H.)

25127 LAMS-2445(p.90-3)

Los Alamos Scientific Lab., N. Mex.

METABOLISM OF ZIRCONIUM⁹⁵ AND RUTHENIUM¹⁰⁶ IN MAMMALS. C. R. Richmond, J. E. Furchner, and G. A. Trafton.

Results are reported from a multiple tracer experiment on gastrointestinal absorption of Zr⁹⁵/Nb⁹⁵, Ru¹⁰⁶/Rh¹⁰⁶, and Ce¹⁴⁴/Pr¹⁴⁴ in rats. Whole-body retention data for 140 days are included for two groups of rats injected intraperitoneally with tracer doses of Ru¹⁰⁶/Rh¹⁰⁶ and Zr⁹⁵/Nb⁹⁵ and assayed periodically in an *in vivo* scintillation counter. (C.H.)

25128 LAMS-2445(p.133-5)

Los Alamos Scientific Lab., N. Mex.

TOTAL BODY POTASSIUM IN MAN. B. E. Clinton, W. H. Langham, and E. C. Anderson.

Results of measurements on the potassium concentration of the human body, determined by whole-body counting of the K⁴⁰, as a function of age for 1590 subjects were compared with measurements made elsewhere by the same and other methods. Good agreement was found. (C.H.)

25129 LAMS-2445(p.204-7)

Los Alamos Scientific Lab., N. Mex.

CARBON¹⁴ IN CITRUS FRUIT OILS [AND] OLD ESSENTIAL OILS. V. N. Kerr, F. N. Hayes, et al.

Data are presented on the C¹⁴ activity in 63 samples of citrus oil measured between 1955 and 1959. A rise in activity is shown graphically. Data are also presented on C¹⁴ in samples of lemongrass, citrus oils, and gum turpentine dating from 1940 to 1953. (C.H.)

25130 LAMS-2445(p.285-90)

Los Alamos Scientific Lab., N. Mex.

EFFECT OF SINGLE SUBLETHAL DOSES OF NITROGEN MUSTARD (HN₂) ON LIFE SPAN AND TUMOR INCIDENCE AS COMPARED TO WHOLE BODY X IRRADIATION. I. U. Boone, G. Trafton, et al.

Results are reported from a study of long-term and delayed effects of nitrogen mustard as compared to the effects of sublethal doses of whole-body irradiation in mice. Data are tabulated and results are discussed. (C.H.)

25131 LAMS-2445(p.322-5)

Los Alamos Scientific Lab., N. Mex.

TOXICITY, METABOLISM, AND TISSUE DISTRIBUTION OF C¹⁴-LABELED TRIETHYLENE THIOPHOSPHORAMIDE (THIO-TEPA) IN RATS. I. U. Boone and D. L. Williams.

Results are reported from a study of the toxicity, metabolism, and tissue distribution of C¹⁴-labeled triethylene thiophosphoramidate in rats. (C.H.)

25132 LAMS-2445(p.329-33)

Los Alamos Scientific Lab., N. Mex.

PREPARATION OF A LINEAR ALPHA SOURCE. T. T. Trujillo, J. D. Perrings, and J. M. Wellnitz.

A linear alpha source was prepared for use in exposing tissue cells either in a mass or in single layers. The source was prepared by electroplating a known amount of plutonium on a very thin wire which could be introduced into the cell culture. Methods and results are described. (C.H.)

25133 LAMS-2445(p.337-47)

Los Alamos Scientific Lab., N. Mex.

CLINICAL APPLICATIONS OF WHOLE-BODY SCINTILLOMETRY. I. RETENTION OF ORALLY ADMINISTERED IRON. C. C. Lushbaugh and D. B. Hale.

The whole-body counting technique for determining per cent retention of an orally administered tracer dose of Fe⁵⁹

appears to be a facile means of measuring absorption of orally administered iron. Results are reported from a preliminary study which indicate that there are many facts about intestinal iron absorption in various diseases and normal physiological states which warrant further investigation. The apparent lack of iron absorption in the anemias of the three leukemias and in acute infections is not understandable in the light of present knowledge. The remarkably high iron absorption observed in one pregnant woman and the large proportion of the oral dose found subsequently in the placenta and infant emphasize the need for more data on oral iron retention in pregnancy. The increased sensitivity of the new human counter now under construction will provide accurate measurements of Fe⁵⁹ uptake with doses of less than 0.1 μ c. This will permit such studies to be made more safely and more frequently in young persons and in early pregnancies. (auth)

25134 LAMS-2445(p.348-60)

Los Alamos Scientific Lab., N. Mex.

CLINICAL APPLICATIONS OF WHOLE BODY SCINTILLOMETRY. II. A COMPARISON OF THREE DIFFERENT METHODS OF DETERMINING RETENTION AND THYROID UPTAKE OF ORALLY ADMINISTERED I¹³¹. C. C. Lushbaugh and P. S. New.

Comparisons of whole-body counting with conventional local counting of the gland itself, as a method for determination of thyroid I¹³¹ retention, were followed in 17 patients chosen at random using a 9 by 6 in. sodium iodide crystal, a whole-body liquid scintillation counter, and a 3 by 3 in. collimated sodium iodide crystal placed over the gland. Results of these studies suggest that radioassay of NaI¹³¹ retention by the whole-body liquid scintillometer is a valid, simple, and facile means of determining thyroidal iodine binding and hence thyroidal function. Additional studies in rats and humans, under various experimental and clinical conditions, extend these observations and support this conclusion by showing that the per cent retention of orally administered iodine in the whole-body depends upon relative need for iodine, thyroidal and pituitary activity, and renal function. (auth)

25135 LAMS-2445(p.361-74)

Los Alamos Scientific Lab., N. Mex.

CLINICAL APPLICATIONS OF WHOLE BODY SCINTILLOMETRY. III. WHOLE BODY RETENTION OF IODINE¹³¹ AS A METHOD OF STUDYING THYROID FUNCTION IN MAN. C. C. Lushbaugh and D. B. Hale.

Observations on humans demonstrate that I¹³¹ retention function changes with disease, chemotherapy, and metabolic status. Results are reported from a series of studies. It was concluded that unbound I¹³¹, after gastric absorption, is excreted rapidly by the kidneys (half-time 7 to 10 hr); bound I¹³¹, after entrapment by the thyroid gland, is lost slowly by the urinary route (half-time about 50 days); the rate of urinary loss of I¹³¹ from the bound iodide pool is determined by daily iodide intake, size of free iodide pool (specific I¹³¹ activity), thyroid binding activity, rate of conversion of thyroglobulin to thyroxine, and competitive ratio of renal function to thyroid function; and the percentage of oral tracer dose retained by thyroid binding is dependent upon the same factors as the rate of urinary loss and expresses the equilibrium state of the patient's iodine metabolism, which can be studied by whole-body I¹³¹ retention measurements. (auth)

25136 LAMS-2445(p.375-83)

Los Alamos Scientific Lab., N. Mex.

IODINE¹³¹ RETENTION IN NORMAL AND STARVED RATS. C. C. Lushbaugh and D. B. Hale.

A scintillation well counter large enough to hold an entire rat was used in measurements of iodine retention in rats. Data are tabulated on the effect of starvation of whole-body retention and distribution of I^{131} . (C.H.)

25137 LAMS-2445(p.400-1)

Los Alamos Scientific Lab., N. Mex.

A STAIN MODIFICATION FOR PRECISE IDENTIFICATION OF THREE CONNECTIVE TISSUES. G. L. Humason and C. C. Lushbaugh.

A staining procedure is described by which elastin, reticulum, and collagen can be selectively demonstrated on the same slide. (C.H.)

25138 TID-6513

Wisconsin. Univ., Madison.

RADIOISOTOPE EXCHANGE STUDIES IN LAKES. Progress Report for February 1960-January 1961. 26p. Project No. 12. Contract AT(11-1)-64. OTS.

A large portion of the area which encompasses northern Wisconsin and upper Michigan is comprised of lakes which are of a dystrophic nature. These lakes contribute nothing to the economy of the area, because of their relative infertility. Results are reported from a study of methods for converting these lakes into productive bodies of water which will permit the growth of fish for food and recreation. Data are included from a quantitative chemical analysis of lake water using ion-exchange resins, an investigation of the nutrient status of bog lakes, tracer studies of the exchange of elements across the chemocline of a meromictic lake, and tracer studies of ionic transport in an ice-covered lake. (C.H.)

25139 TID-6523

Illinois. Univ., Urbana.

RÉSUMÉ OF ALL RESEARCH CONDUCTED DURING TENURE OF CONTRACT, JULY 1953 TO SEPTEMBER 1960. George Wolf. 7p. Project No. 12. Contract AT(11-1)-67. OTS.

Research is reported on metabolism of histidine and hydroxy proline, collagen biosynthesis, carnitine biosynthesis and metabolism, and ergothioneine synthesis and metabolism. (T.R.H.)

25140 UCRL-9235

California. Univ., Berkeley. Lawrence Radiation Lab. BIOLOGY AND MEDICINE SEMIANNUAL REPORT, OCTOBER 1959 THROUGH MARCH 1960. John H. Lawrence, ed. May 1960. 210p. OTS.

Separate abstracts have been prepared on ten sections of this report. Training programs are reviewed briefly. A list of staff publications during the period is included. For preceding period see UCRL-8988. (C.H.)

25141 UCRL-9235(p.17-24)

California. Univ., Berkeley. Lawrence Radiation Lab. INTERACTION STUDIES BY ELECTROPHORESIS, AND THE STABLE FLOW FREE-BOUNDARY METHOD. Howard C. Mel.

Preliminary results are reported on the development of a stabilized flow system in free solution that permits continuous electrophoretic separations and concentrations to be made of large fluid volumes without the use of any supporting medium and with electrophoresis occurring at right angles to the flow pattern. An apparatus is described which is of symmetrical form. Flows proceed into the main migration chamber through inlets and thence horizontally to the left and out 12 outlets on the opposite side. For electrophoretic-migration experiments, the required electric field is supplied by applying a voltage between the electrodes in the top and bottom compartments. Since these compartments are hydrodynamically isolated from the main

chamber by semipermeable membranes, flows through them can be independently varied without disturbing the main chamber flows. Great flexibility of experimental design is reported to be possible with this apparatus. (C.H.)

25142 UCRL-9235(p.25-8)

California. Univ., Berkeley. Lawrence Radiation Lab. THE INTERNAL STRUCTURE OF A DIATOM. Stafford C. Daniels, Jr., and Thomas L. Hayes. (UCRL-8894).

The fine structure of several fresh-water pennate diatoms was observed and photographed with the aid of an electron microscope. Findings are described and illustrated photographically. (C.H.)

25143 UCRL-9235(p.64-85)

California. Univ., Berkeley. Lawrence Radiation Lab. BODY COMPOSITION FROM FLUID SPACES AND DENSITY: ANALYSIS OF METHODS. William E. Siri.

Methods for estimating body composition from fluid spaces or density, or their combination, are examined with reference to basic premises, formulation, inherent uncertainties, and general conclusions. 17 references. (C.H.)

25144 UCRL-9235(p.86-108)

California. Univ., Berkeley. Lawrence Radiation Lab. DYNAMICS OF BLOOD LIPID TRANSPORT IN HEALTH AND DISEASE. John W. Gofman and Max W. Biggs.

Findings are summarized from a 12-year study of the dynamics of blood lipid transport in health and disease. Results are reported from tracer studies in experimental animals and man. Emphasis was placed on cholesterol, metabolism. Data are included from a study on an apparent metabolic defect in exogenous cholesterol metabolism in atherosclerosis. (C.H.)

25145 UCRL-9235(p.109-27)

California. Univ., Berkeley. Lawrence Radiation Lab. SOURCES AND PROPERTIES OF HUMAN URINARY ERYTHROPOIETIN. Donald C. Van Dyke.

Erythropoietic activity was found only in the presence of severe anemia and only in a small percentage of severely anemic patients. An occasional anemic patient excretes such high titers of erythropoietin in the urine that administration of as little as 1 ml/day to normal rats for 14 days makes them polycythemic. The erythropoietic activity of such urine can be concentrated in stable form by ultrafiltration and adsorption on collodion gel. From one very active patient as much erythropoietin can be collected per day as can be obtained from the plasma of 2 or 3 phenylhydrazine-treated rabbits; this represents approximately 7000 cobalt units per month. Human urinary erythropoietin was shown to be effective in a variety of species, including monkeys. The dose required to produce a 50% increase in total circulating red cells in either rats or monkeys is approximately 60 cobalt units per kg of body weight per day. On this same basis, a 70-kg man would require 4700 cobalt units per day to have a 50% increase in total circulating-red-cell volume. (C.H.)

25146 UCRL-9235(p.129-44)

California. Univ., Berkeley. Lawrence Radiation Lab. MORPHOLOGIC AND AUTORADIOGRAPHIC OBSERVATIONS OF H^3 -THYMIDINE-LABELED THORACIC-DUCT LYMPHOCYTES CULTURED IN VIVO. John C. Schooley and I. Berman.

The *in vivo* method of tissue culture using cellulose ester filter diffusion chambers developed by Algire and co-workers, combined with the autoradiographic method of observing cells labeled with the specific DNA precursor, tritiated thymidine, was used in the experiments described in this paper to study lymphocytopoiesis in an isolated

population of lymphoid cells. In addition, data are presented on the transforming abilities of thoracic-duct cells when cultured in the diffusion chambers, either separately or combined with bone-marrow cells. (auth)

25147 UCRL-9235(p.145-204)

California, Univ., Berkeley. Lawrence Radiation Lab. THE QUANTITATIVE DETERMINATION OF IRON KINETICS AND HEMOGLOBIN SYNTHESIS IN HUMAN SUBJECTS. Myron Pollycove and Robert K. Mortimer.

A mathematical model of iron kinetics is proposed and used in the study of 13 normal subjects and 6 patients with endogenous hemochromatosis. Of central importance to this model is the concept of a labile erythropoietic iron pool interposed between iron bound to transferrin in plasma and iron fixed irreversibly in erythrons for heme synthesis. This model is applied to measurements of radioiron in plasma, circulating red cells, and surface counting rates over liver, spleen, and marrow. Together with measurements of plasma iron concentration and red-cell volume, this permits quantitation of hemoglobin synthesis, mean erythron life span, mean effective erythron-hemoglobinization time, storage-iron deposition, and miscible storage iron. Results are presented that are in agreement with established concepts concerning the life span of normal erythrocytes, erythron maturation, and body iron stores. Increased storage-iron deposition, miscible storage iron, and plasma iron removal were evident in all hemochromatotic patients. Hemoglobin synthesis and erythron life span were normal in five patients with hemochromatosis; one was found to have compensated hemolysis. Erythron hemolysis, whether in marrow or subsequent to erythron entry in the circulation, may be detected and quantitated by analysis of plasma radioiron which, as a result of hemolysis, equilibrates at a constant value in 10 days or less. Evidence is presented suggesting that normally there is insignificant erythron iron bypass of plasma, either by destruction of maturing erythrons in the marrow or via erythrophagocytosis of circulating erythrocytes with subsequent direct transfer of iron into maturing erythrons. 81 references. (auth)

25148 UR-571

Rochester, N. Y. Univ. Atomic Energy Project. BILIARY EXCRETION OF RADIUM IN DOGS. John B. Hursh and Arvin Lovaas. May 18, 1960. 16p. Contract W-7401-eng-49. OTS.

Measurements on bile-fistula in dogs show that the radium contributed by the bile inflow into the small intestine constitutes only a few per cent of the daily amount of radium excreted. This relative amount does not appear to change with time after a single intravenous injection of radium. Other mechanisms whereby radium could enter the gut were considered; it is suggested that although secretion by the cells of the small intestine is likely the most important route, convincing evidence of this is lacking. (auth)

25149 UR-572

Rochester, N. Y. Univ. Atomic Energy Project. URINARY EXCRETION OF RADIUM IN DOGS. J. B. Hursh, A. Lovaas, A. Piccirilli, and T. E. Putnam. May 19, 1960. 17p. Contract W-7401-eng-49. OTS.

After intravenous injection in adult dogs the average radium clearance is about 1.6 ml per minute with a range (in three dogs) from 1.1 to 2.0 ml. The ultrafilterable fraction of the plasma-radium content is measured as approximately 70%. If this value is compared with similar measurements obtained by other investigators for calcium and strontium it may be inferred that there are no impor-

tant differences between binding of these three metals insofar as excretory mechanism is concerned. An average value of 95.3% resorption in the tubules was found for radium which may be compared with 97.5% for strontium and 99.4% for calcium established by other workers. These data lead to the conclusion that the differences in urinary excretion in the dog, as expressed in the relationship $Ra > Sr > Ca$, are brought about principally by corresponding increases in the amount of resorption in the tubules. (auth)

25150 UR-579

Rochester, N. Y. Univ. Atomic Energy Project. RAPID DETERMINATION OF CITRIC ACID IN BIOLOGICAL FLUIDS. Kea Lane and Philip S. Chen, Jr. Aug. 10, 1960. 10p. Contract W-7401-eng-49. OTS.

A modification of the pentabromoacetone method for the determination of citric acid in biological fluids is described. Protein precipitation is effected with trichloroacetic acid. Combined sulfuric acid-metaphosphoric acid and potassium bromide-potassium permanganate reagents are added to convert citric acid to pentabromoacetone. After extraction of pentabromoacetone into heptane, sodium iodide in absolute ethanol is added for color development. Absorbance measurements of the released iodine complex are made at 360 m μ in a single phase solution without need for further extraction. (auth)

25151 USNRDL-TR-426

Naval Radiological Defense Lab., San Francisco. THE SYNTHESIS OF CHYLOMICRA AND MAINTENANCE OF NORMAL BLOOD SUGAR LEVELS BY ISOLATED, PERFUSED RAT LIVER. R. E. Kay and C. Entenman. June 5, 1960. 45p.

Isolated rat livers were perfused for 4.5 hr with whole-blood taken from fed rats. The perfusate, bile, and livers were analyzed for changes in lipids and carbohydrates. In addition, the fate of the C¹⁴ label of injected palmitic acid-1-C¹⁴-labeled chylomicrons was determined. It was shown that the isolated-perfused liver, taken from a fed rat, can synthesize and release chylomicra into the blood. The isolated-perfused liver is able to establish and maintain the blood sugar and lactic acid levels at normal values. The nutritional status of the liver was a determinant factor in the synthesis and utilization of lipids by this organ. (auth)

25152 USNRDL-TR-446

Naval Radiological Defense Lab., San Francisco. HOMOGRAFT-REACTIVE LARGE MONONUCLEAR LEUKOCYTES IN PERIPHERAL BLOOD AND PERITONEAL EXUDATES. L. J. Cole and R. M. Garver. July 20, 1960. 16p.

Two criteria have been employed for demonstrating the presence of homograft-reactive cells in the peripheral blood and in peritoneal exudates: the production of a lethal wasting syndrome in sublethally x-irradiated (500 r) (LxA)F₁ hybrid mice following injection of cells from parental strain (A strain) donor mice and the abrogation of protection by injected bone marrow in lethally x-irradiated mice by these cells. The injection of 8×10^6 peritoneal exudate granulocytes does not elicit the wasting syndrome; whereas 2.1×10^6 mononuclear cells obtained from peritoneal exudates 8 days after mineral-oil administration are reactive. When peritoneal mononuclear cells from isomunized A-strain donors were administered, reactivity of the cells was enhanced. Prior treatment of A-strain donor mice with cortisone did not abolish the homograft reactivity of the injected blood (1.1×10^6 nucleated cells). Under these conditions of cortisone treatment, there was a rela-

tive increase in the frequency of large mononuclear cells (9 μ diameter or larger) and a disappearance of essentially all the small lymphocytes (5 μ –7 μ diameter). Data are presented which indicate the capacity of the large mononuclear cells in peripheral blood to transform into cells of the plasma cell series. It is concluded that the circulating blood contains a mobile pool of large mononuclear cells capable of division, and potentially able to initiate immunological reactions (i.e., homograft reactions) analogous to that possessed by lymphoid tissue cells. Although the present experiments deal with specific inbred mouse strains, their possible implications for bone marrow therapy in irradiated humans are evident. (auth)

25153 AEC-tr-4237

TECHNIQUES OF QUANTITATIVE EVALUATION OF TWO POPULATIONS OF RED CELLS IN FOUR HIGHLY IRRADIATED SUBJECTS TREATED BY TRANSFUSION OF BONE MARROW. C. Salmon. Translated by C. C. Lushbaugh (Los Alamos Scientific Lab.) from *Rev. franç. études clin. et biol.* 4, 239-41(1959). 9p. JCL.

Survival of red cells after intravenous infusion of homologous bone marrow in 4 patients who had received high doses of radiation was studied by Wurmser's technique of differential agglutination involving slight agitation at constant temperature of the mixture of red cells and serum. Anti-C, Anti-c, and Anti-Le^a were utilized. For 3 patients, it was also possible to establish by the same method the percentage of their own cells through an Anti-E serum. Statistical study of the results obtained shows that the coefficient of variation is about 5/100. The data obtained through Anti-Le^a reveal that this antibody may prove useful for evaluation of red-cell survival and that the Le^a substance remains attached to the cell surface for its whole life. (auth)

25154 JPRS-2707

MEDICAL RADIOLOGY. Translation of *Meditsinskaya Radiologiya*, Volume IV, No. 10, 1959. 108p. OTS.

25155 JPRS-2546

MEDICAL RADIOLOGY. Translation of *Meditsinskaya Radiologiya*, Volume IV, No. 3, pages 1-13; 21-39; 42-3; 61-70; 80-1; 89-91; 95-6, 1959. 83p. OTS.

25156 JPRS-2546(p.6-16)

MATERIALS ON THE DISTRIBUTION OF RADIOACTIVE ANTIMONY. Yu. I. Moskalev. Translated from *Med. Radiol.* 4, No. 3, 6-13(1959).

Data are given on the distribution of Sb¹²⁵ in the organs of rats when given orally or intravenously. Early in the experiment, the greatest concentration was found in the kidneys, blood, adrenals, thyroid, lymph nodes, skin, lungs, and heart, and the least in the brain. Throughout the experiment the highest content was consistently found in the skeleton. In a toxicological sense Sb¹²⁵ is not a serious threat, being largely excreted in the urine within the first day. (T.R.H.)

25157 JPRS-2546(p.47-9)

THE EXCRETION IN THE URINE OF RADIOACTIVE POTASSIUM IN MAN AS A FUNCTION OF AGE. L. A. Kachur, S. E. Manoilov (S. Ye. Manoylov), M. N. Pobedinskiĭ (Pobedinskiy), L. R. Protas, V. I. Feoktistov, and G. A. Sheshina. Translated from *Med. Radiol.* 4, No. 3, 42-3 (1959).

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 13, as abstract No. 14199.

25158 JPRS-2546(p.50-7)

THE PREPARATION OF SODIUM CHROMATE (Na₂Cr⁵¹O₄)

AND OF CHROMIUM CHLORIDE (Cr⁵¹Cl₃) AND THEIR USE IN LABELING ERYTHROCYTES AND PLASMA PROTEINS. M. M. Golutvina, M. G. Shitikova, V. I. Levin, and R. V. Lenskaya. Translated from *Med. Radiol.* 4, No. 3, 61-5 (1959).

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 13, as abstract No. 14204.

25159 JPRS-2705

MEDICAL RADIOLOGY. Translation of *Meditsinskaya Radiologiya*, Volume IV, No. 8, pages 3-9; 17-32; 49-71; 81-91, 1959. 97p. OTS.

25160 JPRS-2705(p.65-72)

THE REACTIVITY OF THE BLOOD VESSELS UNDER CONDITIONS WHERE THE ORGANISM IS AFFECTED BY POLONIUM. V. V. Vasil'skaya (Vasil'yevskaya). Translated from *Med. Radiol.* 4, No. 8, 66-71(1959).

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 13, as abstract No. 20836.

25161 JPRS-2743

MEDICAL RADIOLOGY. Translation of *Meditsinskaya Radiologiya*, Volume IV, No. 12, 1959. 160p. OTS.

25162 JPRS-5016

MEDICAL RADIOLOGY. A translation of *Meditsinskaya Radiologiya*, Vol. V, No. 4, 1960. 259p. OTS.

25163 JPRS-5016(p.31-42)

THE USE OF RADIOACTIVE COLLOIDAL GOLD IN THE TREATMENT OF CARCINOMA OF THE CERVIX. S. I. Pavlenko, O. M. Nosalevich, and E. M. Krastina. Translated from *Med. Radiol.* 5, No. 4, 15-18(1960).

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 14, as abstract No. 15505.

25164 JPRS-5016(p.128-33)

PHYSICO-CHEMICAL PROPERTIES OF A NEW RADIOTHERAPEUTIC PREPARATION CONTAINING P³². V. I. Levin, N. G. Serebryakov, and M. D. Kozlova. Translated from *Med. Radiol.* 5, No. 4, 53-5(1960).

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 14, as abstract No. 15507.

25165 JPRS-5078

MEDICAL RADIOLOGY. Translation of *Meditsinskaya Radiologiya*, Volume V, No. 2, 1960. 260p. OTS.

25166 JPRS-5078(p.131-41)

THE INFLUENCE OF THE CALCIUM-DISODIUM SALT OF DIAMINOCYCLOHEXANETETRAACETIC ACID ON THE PLUTONIUM METABOLISM IN RATS. Yu. A. Belyayev. Translated from *Med. Radiol.* 5, No. 2, 54-8(1960).

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 14, as abstract No. 12512.

25167 JPRS-5078(p.142-53)

SOME DATA ON THE PASSAGE OF S³⁵ MERCAPINE THROUGH THE PLACENTA AND ITS DISTRIBUTION IN THE MATERNAL AND FETAL ORGANS. V. I. Bodyazhina and A. P. Kiryuschenkov. Translated from *Med. Radiol.* 5, No. 2, 58-62(1960).

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 14, as abstract No. 12432.

25168 JPRS-5124

MEDICAL RADIOLOGY. Translation of *Meditsinskaya Radiologiya*, Volume V, No. 3, 1960. 253p. OTS.

25169 JPRS-5124(p.110-16)

THE USE OF ION-EXCHANGE RESINS AFTER THE ENTRANCE OF PLUTONIUM INTO THE GASTROINTESTINAL TRACT. Yu. A. Belyaev (Belyayev). Translated from Med. Radiol. 5, No. 3, 44-7(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 13572.

25170 JPRS-5124(p.117-29)

THE PROBLEM OF THE APPLICATION METHOD OF RADIATION THERAPY. A. F. Bogoyavlenskii (Bogoyavlensky), I. F. Bogoyavlenskii (Bogoyavlensky), V. F. Bogoyavlenskii (Bogoyavlensky), and L. S. Rachevskaya. Translated from Med. Radiol. 5, No. 3, 47-51(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 13557.

25171 JPRS-5124(p.130-9)

HYGIENIC STANDARDIZATION OF THE ARRANGEMENT OF COBALT AND X-RAY APPARATUSES. G. I. Meleshko. Translated from Med. Radiol. 5, No. 3, 52-6(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 13968.

25172 JPRS-5124(p.160-74)

THE APPLICATION OF STATISTICS TO RESEARCH IN THE FIELD OF MEDICAL RADIOLOGY. V. D. Serebryanikov. Translated from Med. Radiol. 5, No. 3, 65-70(1960).

The necessity for use of statistical analysis in some of the medical radiology problems is pointed out. Examples are given from research reports to show the errors that arise and how they might have been avoided by correct methodology. It is concluded that radiologists should have a foundation in statistics, and that research should be evaluated by statistical methods. (T.R.H.)

25173 JPRS-5370

RADIATION THERAPY OF MALIGNANT BONE TUMORS. S. A. Pokrovskii (Pokrovskiy), A. M. Semenova, and P. Ya. Nekrasov. Translated from Novyi Khirurg. Arkh. Ukr. S.S.R. No. 2, 89-96(1960). 14p. OTS.

Evidence is given to show that surgery alone is relatively ineffective in curing bone tumors, and results of a study employing massive irradiation followed by surgical intervention are presented. 57 cases were studied. It was found that radiotherapy, as the first step in a combination treatment, eliminated pain, improved function of the extremity, and in 34 of the 57 cases inhibited tumor growth. The therapy, involving doses of 10,000 to 15,000 r, was well tolerated, served to improve morale, and eliminated some amputations and ex-articulations. (T.R.H.)

25174 JPRS-5403

MEDICAL RADIOLOGY. A Translation from Meditinskaya Radiologiya, Volume V, No. 5, 1960. 235p. OTS.

25175 JPRS-5403(p.18-33)

THE USE OF RADIOACTIVE ISOTOPES AND RADIATION FOR THE TREATMENT OF MALIGNANT TUMORS AND OTHER DISEASES. A. V. Kozlova. Translated from Med. Radiol. 5, No. 5, 10-16(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 20067.

25176 JPRS-5403(p.57-63)

RADIOACTIVE PHOSPHORUS TREATMENT OF PATIENTS WITH POLYCYTHEMIA VERA AND LYMPHOGRANULOMATOSIS [HODGKIN'S DISEASE]. N. P. Makletsova. Translated from Med. Radiol. 5, No. 5, 26-9(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 20068.

25177 JPRS-5403(p.73-80)

DOSE OF IONIZING RADIATION IN X-RAY DIAGNOSTIC INVESTIGATIONS. V. I. Abgarov, S. S. Fatalieva (Fataliyeva), and F. A. Aliyeva (Aliyeva). Translated from Med. Radiol. 5, No. 5, 33-7(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 20069.

25178 JPRS-5403(p.113-21)

COMPARATIVE DATA ON THE PERMEABILITY OF THE HEMATO-ENCEPHALIC BARRIER FOR ARTIFICIAL RADIOACTIVE ISOTOPES OF PHOSPHORUS AND BROMINE. M. Ya. Maizelis (Mayzelis). Translated from Med. Radiol. 5, No. 5, 52-5(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 20070.

25179 JPRS-5403(p.122-35)

SOME PROBLEMS OF RADIATION HYGIENE IN THE DEPARTMENTS OF RADON THERAPY. I. I. Gusarov. Translated from Med. Radiol. 5, No. 5, 56-62(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 20071.

25180 JPRS-5500

THE FUNCTION OF THE THYROID GLAND IN DIABETES MELLITUS ACCORDING TO DATA FROM RADIOACTIVE IODINE INDICATION AND BASAL METABOLISM. (Funktsiya Shchitovidnoy Zhelezy pri Sakharom Diabete po Dannym Indikatsii Radioaktivnym Yodom i Osnovnogo Obmena). Z. I. Tsukhno. Translated from Problemy Endokrinol. i Gormonoterap. 6, No. 3, 86-90(1960). 9p. OTS.

A study was made of the functional state of the thyroid gland in 78 patients with diabetes mellitus using I^{131} . It was found that the level of 2-hr I^{131} uptake was normal in 38 of 65 patients; however, it varied in some cases where there was no clinical evidence of disrupted thyroid function. The 24-hr values were normal. With concomitant thyrotoxicosis the uptake increased. No parallelism was found between I^{131} uptake and basal metabolism. The basal metabolism reduction in diabetics is apparently of extra-thyroid etiology. (T.R.H.)

25181 UCRL-Trans-560

ELECTRON PARAMAGNETIC RESONANCE SPECTRA OBSERVED WHEN LEAVES OF PLANTS ARE ILLUMINATED, AND THE PHOTOREDUCTION REACTIONS OF CHLOROPHYLL AND ITS ANALOGUES. N. N. Bubnov, A. A. Krasnovskii (Krasnovskiy), A. V. Umrikhina, V. R. Tsepalov, and V. Ya. Shlyapintokh. Translated by Richard B. Mudge from Biofizika 5, 121-6(1960). 19p. (Includes original, 6p.). JCL or LC.

The electron paramagnetic resonance method was used to make a comparative study of the radical intermediate products formed in the photochemical stage of photosynthesis and in model systems. Free radicals were detected in photoreduction of chlorophyll a, chlorophyll a + b, pheophytin a + b, hematoporphyrin, and magnesium phthalocyanin. The spectrum of the radicals in the model systems as well as in leaves is a doublet with separation $\Delta H \sim 1.8$ oersteds. The g factor is 2.004. Several factors indicate that the spectrum belongs to the radical oxidized form of ascorbic acid. In model systems this radical may be formed by the light energy absorbed by the pigment or by direct photore-

action of ascorbic acid connected with a strong base. (T.R.H.)

25182 UCRL-Trans-562

EFFECT OF CAROTENE ON THE PHOTOCHEMICAL PROPERTIES OF CHLOROPHYLL. A. A. Krasnovskii (Krasnovskiy), N. N. Drozdova, and E. V. Pakshina. Translated by Richard B. Mudge from *Biokhimiya* 25, 288-95(1960). 26p. (Includes original, 8p.). JCL or LC.

A study was made of the effects of carotene on the photochemical reactions of chlorophyll. Carotene is inactive in photoreduction and photosensitization reactions. Carotene inhibits all of the photochemical reactions of chlorophyll examined: photoreduction, photo-oxidation, and photosensitization of redox processes. The inhibition phenomenon is observed only if the carotene and the chlorophyll are in one phase; colloidal carotene does not affect the photoreactions of colloidal chlorophyll. (auth)

25183

FISSION PRODUCTS AND THE DAIRY COW. 2. SOME ASPECTS OF THE METABOLISM OF THE ALKALINE-EARTH ELEMENTS CALCIUM, STRONTIUM AND BARIUM. R. J. Garner, H. G. Jones, and B. F. Sansom (Agricultural Research Council, Compton, Berks, Eng.). *Biochem. J.* 76, 572-9(1960) Sept.

Ca^{45} and Sr^{86} , Sr^{89} and Ba^{140} , or Ca^{45} and Ba^{140} were administered simultaneously, both orally and intravenously, to pairs of lactating cows. Data are presented on the mean recoveries during eight days following administration of the isotopes. Calculations of individual discrimination factors indicate that absorptive discrimination made the most important contribution to over-all discrimination between calcium, strontium, and barium during their passage from diet to milk. Mammary secretion significantly influenced strontium discrimination. Renal excretion, endogenous secretion into the gut, and mammary secretion were approximately equal for barium. The metabolism of Ca^{45} , Sr^{89} , and Ba^{140} in the cow is discussed and data are compared with those on rats. (C.H.)

25184

MODIFICATION OF STRONTIUM 90 EMISSION FOR SUPERFICIAL THERAPY. Basil S. Proimos, Kenneth A. Wright, and John G. Trump (Massachusetts Inst. of Tech., Cambridge). *Brit. J. Radiol.* 33, 640-3(1960) Oct.

The heteroenergetic emission of β particles from radioactive materials may be modified for the more favorable treatment of superficial disease. In this study the β particles emitted by a Sr^{90} source within an angle of 80° were screened and redirected by a magnetic selector. The output consisted of a broad field of electrons moving in about the same direction and with a selected range of energies controllable by the magnetic field. The distribution of ionization in depth of tissue produced by the highest energy band, 1.4 to 2.1 Mev, was similar to that produced by monoenergetic 1.6-Mev electrons. (auth)

25185

AN IODINE 131 DISPENSER FOR CLINICAL USE. J. P. Keene (Christie Hospital and Hold Radium Inst., Manchester, Eng.). *Brit. J. Radiol.* 33, 651-3(1960) Oct.

A dispenser is described which was planned for the rapid routine dispensing of doses of I^{131} solution in the range of 1 to 20 mc from a stock vessel into paper cups for use in the treatment of thyrotoxicosis. (C.H.)

25186

THE EFFECT OF GROWTH AND THYROID HORMONES UPON THE REMOVAL BY LAVAGE OF CALCIUM AND STRONTIUM FROM THE SKELETON OF THE RAT. F. W. Lengemann, R. H. Wasserman, and C. L. Comar (State

Univ. Veterinary Coll., Ithaca, N. Y.). *Endocrinology* 67, 535-9(1960) Oct.

Intraperitoneal lavage was used to remove some of the previously deposited radiostrontium and radiocalcium from the skeletons of rats. The efficiency of radioisotope removal was taken as an index of the incorporation of the radionuclide from the labile into the less-labile portions of bone. The data showed that removal efficiency decreased with time from dosing until the start of lavage. In hypophysectomized rats as compared to normals, removal efficiency was increased at 24 hr after lavage but not at 8 or 48 hr. Supplying growth hormone to hypophysectomized rats decreased the amount of radioisotope that could be removed by lavage at 24 hr after dosing. Thiouracil, when fed to intact rats, increased the amount of radioisotopes that could be removed; however, thiouracil fed to hypophysectomized rats receiving growth hormone did not produce this response. (auth)

25187

URINARY EXCRETION OF β -AMINO-ISOBUTYRIC ACID AFTER INJECTION OF THYMIDINE LABELLED WITH TRITIUM. Georg B. Gerber, Gisela Gerber, and Kurt I. Altman (Univ. of Rochester, N. Y.). *Nature* 187, 956-7 (1960) Sept. 10.

Each of five rats was injected intraperitoneally with tritium labeled thymidine in three equal doses at 3 hr intervals. Pooled urine samples were collected during successive days. The rats were killed at various times after injection of the H^3 -thymidine. Deoxyribonucleic acid was isolated from several organs, and β -amino-isobutyric acid was isolated from the urine specimens. The specific activity of the β -amino-isobutyric acid decreased rapidly during the initial 3 days but only gradually thereafter. Since on the second day the specific activity of tissue deoxyribonucleic acid exceeded that of urinary β -amino-isobutyric acid, it appeared reasonable to assume that the breakdown of deoxyribonucleic acid contributed significantly to the labeling of β -amino-isobutyric acid. (M.C.G.)

25188

EFFECT OF HEAVY WATER ON RESPIRATORY-CHAIN ENZYMES. H. Laser (Univ. of Cambridge, Eng.) and E. C. Slater. *Nature* 187, 1115-17(1960) Sept. 24.

The respiratory-rate of bacteria was decreased by approximately 45% and that of baker's yeast by 75% in 95 to 98% heavy water as compared with light water. The rate of anaerobic fermentation of *E. Coli* on the other hand was not affected by heavy water for the first 2 hr. The rate of aerobic succinate oxidation in heart-muscle preparation was increasingly inhibited with increasing concentration of heavy water. The maximum inhibition was between 45 and 50% in 99% heavy water. The rate of anaerobic oxidation of succinate with methylene blue as a hydrogen acceptor was not affected. (M.C.G.)

25189

THE TRANSFUSION OF H^3 -THYMIDINE LABELLED HOMOLOGOUS BONE MARROW INTO TOTAL BODY IRRADIATED RATS. Theodor M. Fliedner (Universität, Heidelberg, Ger.). *Nuclear-Med.* 1, 299-313(1960). (In German)

Tritium labeled thymidine was incorporated *in vitro* into bone marrow cells during DNA-synthesis thus indicating their proliferative potentials. Thymidine labeled bone marrow cells were transfused into total body irradiated rats immediately after γ irradiation (Co^{60}). The labeled cells were traced in marrow, spleen, and lymphnode smears by means of high resolution autoradiography. The recipient, irradiated rats were sacrificed 1, 14, and 38 hr after transfusion of the labeled cell suspension. A fraction

of the labeled cells was found in bone marrow, spleen, lymphnode, and blood of the irradiated recipient. One hour after injection a fraction of labeled immature cells was still present in the peripheral blood. After 38 hr some labeled segmented neutrophils were found in the peripheral blood; this indicated proliferation and maturation of transfused, labeled precursor forms. It was concluded that transfused immature bone marrow cells were able to divide and mature in radiation damaged organs. The small number of labeled cells per total number of marrow cells in the recipient bone marrow suggested that the proliferative potential of transfused bone marrow cells into irradiated recipients may not be the most important factor for the stimulation of the bone marrow recovery seen after marrow cell transfusions. (auth)

25190

NUCLEIC ACIDS IN SOME DEUTERATED GREEN ALGAE. E. Flaumenhaft (Hiram Coll., Ohio), S. M. Conrad, and J. J. Katz. *Science* **132**, 892-4(1960) Sept. 30.

In order to determine whether or not the replacement of hydrogen by deuterium in living organisms is accompanied by changes in amounts and distribution of the cellular components, a preliminary cytochemical investigation was made on deuterated *Chlorella vulgaris* and *Scenedesmus obliquus*. Cytoplasmic ribonucleic acid was more widely distributed and occurred in higher quantities in deuterated than in nondeuterated algae. Nuclei of deuterated cells were more irregular in shape, and mitotic figures appeared with greater frequency in the deuterated organisms. (auth)

25191

RESEARCH ON THE EGGS OF *ASCARIS MEGALOCEPHALA* AS A BASIS FOR FRACTIONATED THERAPY WITH ELECTRONS. Günther Oehlert (Universitäts, Frauenklinik, Giessen, Ger.). *Strahlentherapie* **113**, 42-82(1960) Sept. (In German)

As a basis of examinations on the action of fractionally delivered radiation with electrons and x rays on single-cell eggs of *Ascaris megalocephalus*, the biological action of rays of high energy was reported. The characteristics of the test objects and the working method, as well as the results of the determination of the biological dosage equivalent between the ultra-hard x rays and electrons of Sr^{90} , are given. Thereby, it was shown that ultra-hard x rays have a stronger biological action with a single-phase radiation; so they resulted in dosage equivalent factors of less than one. A dependency of the dosage equivalent upon the used total dosage and the dosage power is shown. Continuing the examinations on the biological action of fractionally delivered ultra-hard x rays and electrons of Sr^{90} , it was shown that a fractioned radiation of both radiation types has a stronger action than does a single intensive radiation, and that the radiation effect of x ray and radiation with electrons is influenced by the length of interval. Whereas a dosage dependency of the fractionizing factor can not definitely be demonstrated, fractioned radiation with electrons, taking into consideration the biological dosage equivalent, turns out to be superior in action to a corresponding radiation with ultra-hard x rays. Finally the possible useful application of the results of the examinations for the therapy is discussed. (auth)

25192

DOSIMETRY OF RADIOACTIVE SEEDS. Dietrich Frost (Röntgen- und Strahleninstitut des Städt. Rudolf-Virchow-Krankenhauses, Berlin). *Strahlentherapie* **113**, 136-9(1960) Sept. (In German)

General equations were drawn up for the dosage of

radioactive seeds. These equations assume a simple form in the case of the implantation from Au^{198} . In practice the relationship between the activity of the single radiation source and its distance to the other radiation sources is decisive. On a graphic presentation the optimal implantation distance dependent on the seed activity is therefore shown. (auth)

25193

MEDICAL APPLICATIONS OF SHORT HALF-LIFE ISOTOPES. William S. Maxfield (Johns Hopkins Hospital, Baltimore). *Texas Eng. Expt. Sta. Misc. Publ. E 72-60* 57-61(1960) Apr.

The radioactive isotopes that are obtainable from commercial suppliers and that are used in the field of medicine are listed with their half-lives. Some of the specific uses of these isotopes in medicine are described. (W.L.H.)

25194

PROBLEMS ENCOUNTERED IN IN VIVO LOCALIZATION OR RADIOACTIVITY AND SOLUTIONS TO A FEW OF THEM. C. C. Harris, J. E. Francis, and P. R. Bell (Oak Ridge National Lab., Tenn.). *Texas Eng. Expt. Sta. Misc. Publ. E 72-60* 62-6(1960) Apr.

Some of the problems encountered in in vivo localization of radioactivity that have existed since its start and how they stand now are discussed. The basic process consists of giving a patient a γ -emitting pharmaceutical and attempting to discern where this substance goes in the body as contrasted with the normal distribution of that dose. Some of the problems considered are the directionalizing capability of the radiation counter, the absorption of more tracer by abnormal tissue than by normal tissue, the machinery that moves the detector around, and the plotting of the activity map. (W.L.H.)

25195

INTERSTITIAL RADIUM THERAPY OF MALIGNANT TUMOURS WITH THE AID OF NYLON TUBES CONTAINING RADIOCOBALT GRANULES. A. S. Pavlov. *Vestnik Rentgenol. i Radiol.* **35**, No. 3, 34-40(1960) May-June. (In Russian)

Literature data are presented on the employment of nylon tubes charged with radioactive substances for the interstitial-radium therapy of malignant tumors. Employed were modifications of Gauwerky and Mohr's method of the nylon-tube introduction in 44 patients with different localizations of malignant neoplasms. Clinical observations point to definite advantages of the interstitial-radium therapy with the aid of radiocobalt-charged nylon tubes in comparison with the radium-bearing needles, since the tumor is traumatized much less when the nylon tubes are introduced, and their extraction is painless. On the other hand, the time required for this procedure is just one-half of that needed for the introduction and extraction of radium-bearing needles. There was no development of necrotic canal along the radiocobalt-charged nylon tubes, as could be usually seen in employment of radioactive needles. This is due to the fact that at the borderline "needle-tissue" a high radiation dose is being built up because of the electronic emission produced at the expense of the electrons being knocked out by gamma-quantums from the electron shells of the atoms belonging to the metal of which the needle is manufactured. Nylon tubes containing radiocobalt granules were used in radiosurgical interventions. (auth)

25196

RADIATION TREATMENT OF KELOIDS. A. I. Strashinin. *Vestnik Rentgenol. i Radiol.* **35**, No. 3, 40-3(1960) May-June. (In Russian)

A summary is given of the results of radiation and com-

bined treatment of 75 keloids with radon preparations, radioactive cobalt, and gold. The best results were obtained in treating postoperative keloids (out of 8 cases, good results were seen in 6 and satisfactory in 1 patient) and spontaneous keloids (out of 12 patients, good results were obtained in 8 and satisfactory in 3 cases). The results were somewhat inferior in the group of spontaneous keloids treated by excision prior to the radiation therapy (out of 15 patients, good results were obtained in 3 and satisfactory in 6 patients). Radiation therapy proved to be the least effective in keloids resulting from burn (out of 18 patients, satisfactory results were seen in 10 cases and good in 1 patient). Good cosmetic effect in treatment of keloids rising considerably above the skin surface was reached only in combined therapy. The most favorable results were obtained with a dose of 4,000 r, the dose rate being 70 to 100 r/hr, with fractional irradiation. (auth)

25197

RADIATION THERAPY IN GIANT-CELL TUMOURS OF THE JAWS. V. M. Bentsianova and S. Ya. Balsevich. *Vestnik Rentgenol. i Radiol.* 35, No. 3, 44-50(1960) May-June. (In Russian)

There are still many disputable problems in radiation treatment of the giant-cell tumors of the bones, their method and dosage of irradiation, etc. The results are presented of radiation therapy of 36 patients with giant-cell tumors of the jaws (the lower jaw was affected in 28 and the upper in 8 cases). In all the patients the diagnosis was confirmed by biopsy. The method of irradiation involved one complete course of radiation therapy, the total dose constituting 4,000 to 5,000 r. As a result of treatment, pronounced clinical improvement was obtained in all patients; they were cured. With the localization of the processes of the upper jaw the results were evaluated mainly by the clinical data; of 28 cases with tumors of the lower jaw, repair of the bone tissue was revealed in all 28 patients; in 18 patients, who were under observation for a period of over 3 years, and in 6 observed for over 5 years, no relapse was noted. Radiation therapy of giant-cell tumors of the jaws proved to be rather effective and it should be considered a method of choice. Peculiar to the course of repair processes in the lower jaw is the absence of osteolysis. In this connection it is advisable that the course of restorative processes after radiation therapy be studied in long and flat bones separately. (auth)

Biochemistry, Nutrition, and Toxicology

25198 LAMS-2445(p.67-70)

Los Alamos Scientific Lab., N. Mex.

NEPHROTOXICITY OF DIETHYLENETRIAMINE PENTA-ACETIC ACID (DTPA). H. Foreman, C. C. Lushbaugh, et al.

Diethylenetriamine pentaacetic acid (DTPA), injected intraperitoneally in rats at dose levels ranging from 30 to 100 mg/kg daily for 16 days, produced a hyaline glandular type of lesion in all the animals studied. Light hematoxylinophilic, amorphous casts were also observed. The large hyaline droplets caused by the relatively low doses of DTPA were observed to rupture cells. This lesion appears to be potentially serious in view of the widespread tubular degeneration, obstruction, and necrosis. Implications associated with the use of DTPA as a chelation agent for enhancement of elimination of radioisotopes from the body are discussed. Findings are compared with those from an

earlier study on renal damage by ethylenediaminetetraacetic acid. (C.H.)

25199 TID-6530

Western Reserve Univ., Cleveland.

INTERMEDIARY METABOLISM OF CARBOHYDRATES AND RELATED SUBSTANCES. Aug. 8, 1960. 21p. Contract AT(30-1)-1050. OTS.

Activities in an investigation of CO₂ fixing reactions leading to the formation of dicarboxylic acids and the role of these reactions in formation of glycogen and glucose from pyruvate and its precursors are reported. Results indicate that it is unlikely that pyruvic kinase contributes significantly to PEP carboxykinase synthesis. It appears more likely that PEP is formed from oxalacetate. Further investigation of the fructose-1, 6-diphosphatase step in the synthesis of glucose and hexosemonophosphate from fumarate is reported. In other research, the role of acetic acid in oxidation and pentose metabolism in microorganisms, and oxidative phosphorylation in microorganisms were investigated. (J.R.D.)

25200 DEG-Inf-Ser-44

THE QUESTION OF GRAPHITE PNEUMOCONIOSIS.

F. Koelsch. Translated by R. Presser (U.K.A.E.A., Risley) from *Zentr. Arbeitsmed. u. Arbeitsschutz* 8, 31-5(1958). 8p.

The literature on graphite pneumoconiosis is reviewed. The author points out that pure graphite does not occur in nature, and the results of experimental studies indicate that the inhalation of pure graphite does not produce a fibrous lung. The danger from the inhalation of graphite is due to the presence of silica and other constituents. Data are tabulated on the composition of dust in industrial establishments using graphite, both as a raw material and during production. It was concluded that a different material and a different danger from inhalation of dust were present in each case. The purity of the raw-material graphite and the composition of the mixtures used are decisive factors in determining the hazards in industrial establishments. (C.H.)

25201 JPRS-L-924-N

THE EFFICACY OF CERTAIN COMPLEXONES IN THE CAUSAL TREATMENT OF ACUTE Y⁹¹ INTOXICATION.

L. A. Il'in (Il'yin). Translated from *Med. Radiol.* 4, No. 5, 72-6(1959). 11p. OTS.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 13, as abstract No. 15891.

Fallout and Ecology

25202 HASL-90

New York Operations Office, Health and Safety Lab., AEC SUMMARY OF AVAILABLE DATA ON THE STRONTIUM 90 CONTENT OF FOODS AND OF TOTAL DIETS IN THE UNITED STATES. John H. Harley and Joseph Rivera. Aug. 18, 1960. 70p. OTS.

The analysis of foods for Sr⁹⁰ offers the best means of evaluating the possible hazards of fall-out fission products to man, with the exception of analyzing man himself. The study of foods as an intermediate step in the chain from deposition to incorporation into man is also of considerable assistance in the prediction of future body levels. Available data are summarized on the Sr⁹⁰ content of foods and of total diets in the United States. Data are presented from analyses of individual foods, analyses of representative total diets, and special studies. It is concluded that the dietary levels of Sr⁹⁰ will stabilize within a few years and then diminish with time. 31 tables. (C.H.)

25203 LAMS-2445(p.103-17)

Los Alamos Scientific Lab., N. Mex.

MONITORING OF MILK FOR K^{40} , Cs^{137} , AND Ba^{140}/La^{140}

B. Clinton, J. Allen, and E. C. Anderson.

A project to monitor systematically the U. S. powdered milk supply for Cs^{137} , K^{40} , and Ba^{140}/La^{140} was begun in 1956. A summary is presented of 1958 results. Results are compared with those reported previously. (C.H.)

25204 LAMS-2445(p.118-24)

Los Alamos Scientific Lab., N. Mex.

CORRELATION BETWEEN Cs^{137} LEVELS IN PEOPLE AND MILK FROM A SPECIFIC AREA.

B. E. Clinton and E. C. Anderson.

A correlation was made between data on Cs^{137} levels in people and in milk for a sizable local population in the Albuquerque, N. Mex., area. Data are presented graphically on quarterly averages of Cs^{137} content in people and milk samples over a 4-year period. (C.H.)

25205 LAMS-2445(p.125-32)

Los Alamos Scientific Lab., N. Mex. and Columbia Univ.,

Palisades, N. Y. Lamont Geological Observatory.

CORRELATION OF Cs^{137} AND Sr^{90} LEVELS IN MILK.

E. C. Anderson and A. R. Schulert.

Cs^{137} can be easily and rapidly determined with either a liquid scintillator or a sodium iodide crystal counter. The possibility of estimating Sr^{90} concentration in milk from the results of Cs^{137} analysis is considered. The principal uncertainties involved in collecting data are discussed. (C.H.)

25206 LAMS-2445(p.152-6)

Los Alamos Scientific Lab., N. Mex.

RADIOACTIVITY OF NEVADA CATTLE.

M. A. Van Dilla and G. Farmer.

A project was started in 1957 to study possible radiation effects and amounts of fission products deposited in the tissues of cattle raised in the vicinity of the Nevada Test Site. Data are tabulated on the radioactivity of beef liver and muscle samples of animals sacrificed in 1959. (C.H.)

25207 JPRS-2705(p.47-54)**CHARACTERISTICS OF THE DISTRIBUTION AND EXCRETION OF POLONIUM IN ANIMALS WITH THE USE OF UNITHIOL.**E. (Ye) V. Erleksova. Translated from *Med. Radiol.* 4, No. 8, 54-60(1959).

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 13, as abstract No. 20834.

25208 JPRS-5016(p.115-27)**DISTRIBUTION AND EXCRETION OF Rb^{86} IN RATS.**

Yu. I. Moskalev, V. G. Kulikova, and S. A. Rogacheva.

Translated from *Med. Radiol.* 5, No. 4, 47-52(1960).

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 14, as abstract No. 15506.

25209**THE EFFECTS OF ENVIRONMENTAL FACTORS UPON THE ACCUMULATION OF RADIOISOTOPES BY ECOLOGICAL SYSTEMS.**

J. J. Davis (General Electric Co., Rich-

land, Wash.). *Texas Eng. Expt. Sta. Misc. Publ.* E-72-60

37-41(1960) Apr.

Radioactive contaminants from the usage of radioactive materials include debris from the testing of nuclear devices and wastes from industrial, research, and medical users of radioelements. The fate of the radioactive contaminants, subsequent to their initial deposition, is traced. The kinds and amounts of radioelements that become accumulated by plants and animals are described. The fac-

tors affecting this accumulation are also described. (W.L.H.)

25210**THE USE OF RADIOISOTOPES IN ION ABSORPTION BY PLANTS.**

Sterling B. Hendricks (Mineral Nutrition Lab.,

Beltsville, Md.). *Texas Eng. Expt. Sta. Misc. Publ.*

E 72-60 42-6(1960) Apr.

Results obtained with the use of radioisotopes in following the absorption of alkali, alkaline earth, and phosphate ions by plant roots are treated on the basis of Michaelis-Menten kinetics as an example of active transport. Phosphate-ion accumulation is associated with "high energy" bond formation during the absorption process in both barley roots and yeast cells. (auth)

Radiation Effects on Living Tissues**25211** A/AC.82/G/L.400

Hiroshima Univ. School of Medicine.

STATISTICAL OBSERVATIONS ON LEUKEMIAS IN HIROSHIMA DURING THE PAST FOURTEEN YEARS (1946-1959).

Susumu Watanabe, Toshio Ito, and Yasuhide

Matsubayashi. May 1960. 14p.

Tabulations of data collected on leukemia in Hiroshima atomic bomb survivors between 1946 and 1959 are presented. The data include incidence and death-rate figures, types of leukemia, incidence vs. distance from explosion, and incidence vs. sex and age. The incidence of leukemia among Hiroshima bomb survivors is 7.3 times that of the average for Japan. (T.R.H.)

25212 A/AC.82/G/L.402

National Inst. of Genetics, Mishima, Japan.

RELATIVE APPLICABILITY OF THE CLASSICAL AND THE BALANCE HYPOTHESES TO MAN. ESPECIALLY WITH RESPECT TO QUANTITATIVE CHARACTERS.

Motoo Kimura. May 1960. 15p.

A systematic search was made for evidence for or against the Dobzhansky classical and balance hypotheses, especially with respect to quantitative characters. Support is given for the view that among loci connected with a quantitative character in man, overdominant loci are a minority as compared with loci in which genetic variability is maintained by mutation and selection. It was concluded that discussions on the deleterious effect of increased mutation rate caused by radiation are relevant to the former class of loci unless it is shown that radiation tends to produce more heterotic lethals than natural causes. (T.R.H.)

25213 A/AC.82/G/L.403

Tokyo Medical and Dental Univ.

HUMAN GENETIC STUDY IN JAPAN.

K. Tanaka, comp.

May 1960. 19p.

Genetics studies in Japan are described. The effect of consanguinity, congenital abnormalities, genetic effects of radiation in offspring of radiological technicians, and estimation of the doubling dose were studied. (T.R.H.)

25214 AF-SAM-60-57

School of Aviation Medicine, Aerospace Medical Center, Brooks AFB, Tex.

THE EFFECTS FROM MASSIVE DOSES OF HIGH DOSE RATE GAMMA RADIATION ON MONKEYS.

John E. Pickering, Wright H. Langham, and Walter A. Rambach, eds. [1960]. 416p.

Groups of *macaca rhesus* were exposed to radiation from a $Ba-La^{140}$ gamma source, with a strength of approximately 28,000 curies. The radiation field yielded approximately a 45-degree solid angle with consistent dose rates of 1000 to 2000 r/min. Individual radiation doses ranged from 880 to

40,000 r. The survival time of the monkeys varied inversely with the total delivered dose, although there were definite indications that there is a dose range in which survival time is independent of total dose. No animals were killed immediately and the survival times ranged from 3 hr at the highest dose to 11 days at the lowest dose. The effects of massive-dose radiation upon primate behavior was explored using a relatively wide range of stimuli employing both food and shock motivation. The responses ranged from body locomotion requiring a high output of physical energy but demanding little in the way of fine coordination of the smaller muscle groups to low output of physical energy and a high degree of coordination. The tasks employed demanded not only visual discrimination for choosing one or two implements to manipulate, but also an additional discrimination regarding the distance which the implement must be manipulated. Results indicate that massive doses of radiation result in a decrement in the performance of five manipulatory responses and that an increase in dose level tends to be accompanied by an increase in debilitation. Within 1 to 3 min a state of hyperactivity was observed with a peak in debilitation occurring at approximately 3 to 8 min after the onset of radiation. Vomiting and nausea were also apparent at this time, with the severity depending on the time after feeding. Cinematography showed alternating periods of almost complete incapacitation and partial recovery. Data are included on hematology, physiological changes, blood and tissue chemistry, ocular pathology, neuropathology, and general pathology. 132 references. (C.H.)

25215 BLG-43

Brussels. Centre d'Étude de l'Énergie Nucléaire and Belgium. Institut National Pour l'Amélioration des Conserves de Légumes.

ETUDE DE L'IRRADIATION DES SPORES BACTERIENNES PAR UN TRAITEMENT COMBINE IRRADIATION GAMMA-CHALEUR DANS DIFFERENTS MILIEUX DE LEGUMES. (A Study of the Irradiation of Bacterial Spores By a Combined Gamma Irradiation-Heat Treatment in Different Leguminous Media). M. De Proost and R. Pierard. Mar. 10, 1960. 18p.

The combined influence of gamma irradiation and thermal treatment on the inactivation of *Clostridium sporogenes* PA 3679 spores was confirmed. The gamma irradiation appreciably increases the spore sensitivity to heat. The effect of preheating followed by irradiation is less important but is not negligible. The spores of this organism are affected in a similar way in various vegetables. This is indicated for increasing irradiation doses by the decrease of F_{250} and F_{240} in these media. (auth)

25216 LAMS-2343

Los Alamos Scientific Lab., N. Mex.

LITERATURE SEARCH ON THE RELATIVE BIOLOGICAL EFFECTIVENESS (RBE) OF IONIZING RADIATIONS.

Wright H. Langham, ed.—Patricia Bell, Lois Godfrey, and Helen Stearns, comps. Mar. 1960. 251p. Contract W-7405-eng-36. OTS.

Results of a literature search to aid in establishing appropriate values for relative biological effectiveness (RBE) are presented. RBE may be defined as the ratio of the dose of 200- to 250-kv x rays required to produce a specific biological effect to the dose of another radiation required to produce the same level of effect. Although some references may have been missed, the compilation is believed to be relatively complete up to mid-year 1959. No attempt was made to classify the references in specific categories as to radiation type or biological effect; they are listed

merely in alphabetical order according to author. In most cases, the abstracts given are those of the author or the abstracting medium from which the reference was taken. Approximately 500 references are given. (auth)

25217 LAMS-2445(p.11-16)

Los Alamos Scientific Lab., N. Mex.

CONJUGATION OF TAURINE AND CHOLIC ACID IN IRRADIATED ANIMALS. D. F. Petersen and R. G. Gould.

The metabolic pathway leading to excessive taurine excretion in irradiated animals was investigated. Data are presented from measurements of S^{35} -taurocholate conjugation by normal and irradiated rat-liver homogenates and the cumulative renal and biliary excretion of S^{35} -taurine by irradiated bile fistula in rats. (C.H.)

25218 LAMS-2445(p.17-26)

Los Alamos Scientific Lab., N. Mex.

SERUM ENZYMES AFTER X-RAY AND GAMMA-NEUTRON IRRADIATION. D. F. Petersen and L. B. Cole.

A study was made of factors affecting the activity of enzymes in the peripheral circulation following release from radiation-injured tissues. Data are included from studies on rats, rabbits, and rhesus monkeys exposed to x radiation or to a mixed gamma-neutron fission spectrum at doses ranging from 187 to 388 rads. Assays were made of serum concentrations of glutamic-oxalacetic transaminase, glutamic-pyruvic transaminase, lactic dehydrogenase, and malic dehydrogenase. The possibility that the liver plays an important role in inactivation of circulating serum enzymes was investigated by causing liver damage and subsequently measuring the net increase in serum enzyme accumulation due to irradiation. Comparison was made with CCl_4 -poisoned controls. Results are tabulated and discussed. (C.H.)

25219 LAMS-2445(p.37-42)

Los Alamos Scientific Lab., N. Mex.

DEOXYNUCLEOSIDES IN THE URINE OF IRRADIATED ANIMALS AND MAN. D. F. Petersen, M. Magee, and A. Murray, III.

An investigation was made of early changes in the desoxyribose content of the urine of irradiated animals. Compounds contributing to the total desoxyribose were identified in urine from irradiated animals and from two men exposed to gamma-neutron irradiation. Data are tabulated on the content of thymidylic acid, desoxyguanylic acid, guanine desoxyriboside, cytosine desoxyriboside, and adenine desoxyriboside in human urine. (C.H.)

25220 LAMS-2445(p.64-5)

Los Alamos Scientific Lab., N. Mex.

BATYL ALCOHOL AND RADIATION DAMAGE. H. Foreman, M. B. Roberts, and M. Magee.

Preliminary results are reported from a study on the effects of α -octadecylglycerolether (batyl alcohol) on radiation lethality in mice. (C.H.)

25221 LAMS-2445(p.233-5)

Los Alamos Scientific Lab., N. Mex.

HERITABILITY OF RADIATION DAMAGE IN MICE. J. F. Spalding and V. G. Strang.

Preliminary data are presented from a study on the heritability of radiation damage in mice in terms of reproductive performance and life span. (C.H.)

25222 LAMS-2445(p.240-5)

Los Alamos Scientific Lab., N. Mex.

COMPARISON OF NATURAL AND RADIATION AGING MECHANISMS. RESPONSE OF IRRADIATED AND NONIRRADIATED MICE TO COLD STRESS. T. T. Trujillo and J. F. Spalding.

A comparison was made of natural and radiation-induced aging mechanisms in mice as demonstrated by the response of irradiated and nonirradiated animals to cold stress. Data are tabulated and results are discussed. (C.H.)

25223 LAMS-2445(p.250-61)

Los Alamos Scientific Lab., N. Mex.

ACUTE END POINTS AS INDICATORS OF AGING INDUCED BY RADIATION. J. E. Furchner and G. A. Trafton.

The feasibility was explored of using calcium uptake and accumulation in the aorta, kidney hypertrophy after unilateral nephrectomy, and temperature shortening of rat tail tendons as physiological indicators of radiation-induced aging. These three methods show little promise as acute end points of radiation-induced aging. (C.H.)

25224 LAMS-2445(p.265-73)

Los Alamos Scientific Lab., N. Mex.

EFFECT OF SUBLETHAL WHOLE BODY IRRADIATION AT DIFFERENT AGE LEVELS. I. U. Boone, G. Trafton, et al.

The effect of sublethal whole-body irradiation at different age levels was studied in mice. Data are tabulated. (C.H.)

25225 LAMS-2445(p.274-84)

Los Alamos Scientific Lab., N. Mex.

EFFECTS OF PARTIAL AND WHOLE BODY X IRRADIATION ON LIFE SPAN AND TUMOR INCIDENCE OF CF₁ MICE. I. U. Boone, G. Trafton, et al.

Results are reported from a study of the long-term effects of partial-body exposure of mice on shortening of life span, tumor incidence, and age-specific rates of mortality. Data are tabulated and results are discussed. (C.H.)

25226 LAMS-2445(p.291-6)

Los Alamos Scientific Lab., N. Mex.

EFFECT OF PRE-IRRADIATION TREATMENT WITH GLUTATHIONE ON LIFE SPAN AND TUMOR INCIDENCE OF CF₁ MICE. I. U. Boone, G. Trafton, et al.

The effects of glutathione, administered prior to single lethal or sublethal doses of x radiation, on life span, tumor incidence, and age-specific log rates of mortality were studied in mice. Data were compared with findings for mice exposed to single doses of 400-rad whole-body x radiation and for nonirradiated animals. Glutathione had a definite protective effect in terms of life shortening and tumor incidence. Data are tabulated. (C.H.)

25227 LAMS-2445(p.297-316)

Los Alamos Scientific Lab., N. Mex.

NEOPLASMS OCCURRING IN A SERIES OF IRRADIATED MICE. D. C. White.

A study was made of tumor types in irradiated mice. The most frequent tumors observed were pulmonary, mammary, ovarian, and reticulo-endothelial, including the leukemias and lymphomas. Histological findings are reported. A literature survey was made of pertinent literature regarding neoplasms identified in laboratory mice. No significant histologic deviation was found from the categories described. 14 references. (C.H.)

25228 LAMS-2445(p.317-21)

Los Alamos Scientific Lab., N. Mex.

GIANT CELL FORMATION IN HeLa CELLS AS A FUNCTION OF Co⁶⁰ GAMMA AND X IRRADIATION. D. C. White and P. C. Sanders.

The percentage of giant cells formed in HeLa cells in tissue culture after exposure to x or gamma radiation was correlated with radiation dose. A readily reproducible curve was obtained for giant cell production as a function of total radiation dose. (C.H.)

25229 LAMS-2445(p.384-93)

Los Alamos Scientific Lab., N. Mex.

THE QUESTION OF SODIUM LOSS IN THE INTESTINAL DEATH SYNDROME OF RADIATION DAMAGE. C. C. Lushbaugh, J. Sutton, and C. R. Richmond.

Results are reported from an investigation of the effects of acute doses of whole-body irradiation on the distribution and excretion of body sodium. Data are included from studies of Na²² distribution and retention in irradiated rats. A comparison of gross retention rates of Na²² in fasted control and irradiated animals failed to support the idea that increased sodium loss is either caused by radiation or plays a dominant role in the intestinal death syndrome of massive acute radiation exposure. (C.H.)

25230 LAMS-2445(p.394-9)

Los Alamos Scientific Lab., N. Mex.

ADDITIONAL OBSERVATIONS ON ELECTROLYTE AND WATER LOSS IN RADIATION DAMAGE: POTASSIUM⁴² AND HTO. C. C. Lushbaugh, D. B. Hale, and T. T. Trujillo.

Potassium and water loss were studied in normal, starved, and irradiated rats. K⁴² and HTO were used as tracers. Results indicate that potassium is conserved in the starving irradiated rat and that any water loss is proportional to loss of protoplasm. (C.H.)

25231 NP-9038

Medical Coll. of Virginia, Richmond.

MECHANISM OF THE HEMORRHAGIC PHENOMENON PRODUCED IN MALE RATS BY FEEDING OF IRRADIATED BEEF. Progress Report No. 4 [for] Period: September 15, 1959 to March 15, 1960. Susan J. Mellette and Louis A. Leone. 20p. Contract DA-49-007-MD-951.

Further studies were carried out on the susceptibility of female rats to hemorrhage or hypoprothrombinemia associated with irradiated or control beef diets. Female rats again demonstrated only a relative resistance. Susceptibility to hemorrhage or hypoprothrombinemia was greater in groups of animals in which beef feeding was begun prior to maturity than in older females. In contrast, male animals were not found to develop a significant decrease in susceptibility with maturity. As in the male animals previously studied, a higher mortality and lower levels of prothrombin occurred as the quantity of alpha tocopherol administered was increased. Testosterone injected into mature females already receiving irradiated beef diets resulted in a moderate further decrease in prothrombin and a greater mortality. During the 4-week experimental period, testosterone had no effect on prothrombin levels in female animals receiving nonirradiated beef diets, although a few low values occurred in animals given testosterone while being maintained on stock laboratory diets. Accelerator globulin levels were lowered by testosterone without regard to the diet being fed. (auth)

25232 NP-9180

Massachusetts Inst. of Tech., Cambridge.

BREEDING STUDIES ON DOGS RECEIVING IRRADIATED DRIED WHOLE EGGS. Final Report for the Period November 1, 1956 to June 30, 1960. B. E. Proctor, S. A. Goldblith, and S. A. Miller. June 30, 1960. 65p. Contract DA-49-007-MD-755.

Whole dried eggs irradiated to 10⁶ and 3 × 10⁶ rep were fed to 16 beagle dogs for four years and breeding was observed. None of the pups born survived. Biotin supplementation studies indicated improved reproductive performance. Genetic effects and the effects of high-egg diets are being studied as possible causes of reproductive failure. (T.R.H.)

25233 NYO-9339

Yale Univ., New Haven.

FINAL PROGRESS REPORT [FOR] MARCH 1, 1959–MAY 31, 1960. Ernest C. Pollard. 58p. Contract AT(30-1)-568. (YUP-12). OTS

Separate abstracts have been prepared on four sections of this report. (C.H.)

25234 NYO-9339(App.1)

Yale Univ., New Haven.

RADIATION ACTION ON SOME METABOLIC PROCESSES IN *ESCHERICHIA COLI*. Ernest Pollard and Candace Vogler. Appendix 1 of FINAL PROGRESS REPORT [FOR] MARCH 1, 1959–MAY 31, 1960. 11p.Results are reported from studies on the effects of gamma irradiation of *E. coli* on the uptake of P^{32} and S^{35} , the formation of desoxyribonucleic acid, the formation of lipid, and the production of β -D-galactosidase. (C.H.)**25235** NYO-9339(App.2)

Yale Univ., New Haven

ULTRAVIOLET WAVELENGTH-DEPENDENT EFFECTS ON PROTEINS AND NUCLEIC ACIDS. Richard Setlow. Appendix 2 of FINAL PROGRESS REPORT [FOR] MARCH 1, 1959–MAY 31, 1960. 18p.

The effects of ultraviolet light and ionizing radiations on nucleic acids and proteins are compared. (C)

25236 NYO-9339(App.3)

Yale Univ., New Haven.

MODIFYING FACTORS IN THE INACTIVATION OF BIOLOGICAL MACROMOLECULES. Franklin Hutchinson. Appendix 3 of FINAL PROGRESS REPORT [FOR] MARCH 1, 1959–MAY 31, 1960. 19p.

The radiation inactivation of biological macromolecules and the effects of modifying factors on the radiation inactivation are discussed. A model of radiation inactivation is described which relates to the radiation inactivation of protein molecules in the absence of water. Reaction mechanisms are discussed. (C.H.)

25237 NYO-9339(App.4)

Yale Univ., New Haven.

THE EFFECT OF OXYGEN DURING IRRADIATION ON THE UPTAKE OF PHOSPHORUS AND SULFUR BY IRRADIATED CELLS OF *ESCHERICHIA COLI*. Ernest Pollard and Patricia Macauley. Appendix 4 of FINAL PROGRESS REPORT [FOR] MARCH 1, 1959–MAY 31, 1960. 5p.Results are reported from a series of studies on the effects of levels of oxygen and nitrogen during irradiation on the uptake of P^{32} and S^{35} by cells of *Escherichia coli*. (C.H.)**25238** TID-6278

Roscoe B. Jackson Memorial Lab., Bar Harbor, Me.

QUANTITATIVE POPULATION GENETICS OF MICE UNDER IRRADIATION. Progress Report [for] July 1, 1959–June 30, 1960. Earl L. Green. July 1, 1960. 10p. Contract AT(30-1)-1979. OTS.

Two groups of populations of mice are being propagated, generation after generation, under selected levels of gonadal irradiation and of inbreeding. The objective is to assess the effects, if any, of radiation and inbreeding on several characteristics which measure biological fitness. One group of populations, called genetically homogeneous, is descended from a single pair of an inbred strain of mice. The other group, called genetically heterogeneous, is descended from four pairs, one from each of four inbred strains, which were crossed to produce double-cross hybrids. In each group, there are 12 populations with 16

mated pairs per generation. The 12 populations represent all combinations of three levels of radiation (0, 50, 100 r) and four levels of inbreeding. Samples of each population are studied at intervals of from one to four generations for reproductive performance, longevity, activity, radiation resistance, and developmental characteristics. In addition, three associated experiments are in progress, one on the question of genetic extinction due to radiation, one on selection for radiation resistance, and one on the comparative radiosensitivity of mice differing by a single gene at a known locus. (auth)

25239 TID-6328

Atomic Bomb Casualty Commission, Hiroshima.

ACHLORHYDRIA IN HIROSHIMA. RELATION TO AGE, RADIATION AND ABO BLOOD GROUPS. Jerome L. Knittle. [1959]. 17p. OTS.

One thousand two hundred and fifty-one subjects, who were exposed to the atomic bomb in Hiroshima, were examined for the presence of achlorhydria as measured by the Squibb tubeless gastric analysis. The proportion with achlorhydria was analyzed as to age, sex, blood group, and exposure to atomic-bomb radiation. It was found that Japanese subjects, age 40 and over, were more often achlorhydric than the U. S. population and that blood group A subjects were more achlorhydric than group O subjects at ages 30 to 49. No difference was found among persons exposed to atomic-bomb radiation and persons not so exposed; similarly, no difference was found among those exposed to varying amounts of radiation from this source. The data suggest that achlorhydria may be related to the high incidence of gastric cancer in Japan and seem consistent with the hypothesis that achlorhydria occurs prior to gastric cancer and may be related to inherited factors. (auth)

25240 TID-6582

Iowa State Univ. of Science and Technology, Ames.

A QUANTITATIVE STUDY OF LIFETIME SICKNESS AND MORTALITY AND PROGENY EFFECTS RESULTING FROM EXPOSURE TO PENETRATING IRRADIATION. Summary of Progress and Contemplated Work Program, 1960-1961. John W. Gowen and Janice Stadler. 122p. Contract AT(11-1)-107. OTS.

The effects of *in utero* x irradiation upon prenatal and postnatal development was investigated in mice. Morphological anomalies, neonatal mortality, and birth weight were studied as functions of dose rates of 20, 80, 160, and 320 r. The differential response observed in both the induction of malformations and in the incidence of neonatal deaths between inbred and hybrid genotypes is discussed. The nature of the effect of 320 r x irradiation on volitional activity and its relationship to genetic backgrounds were examined in mice. A reduction in activity of whole-body irradiated mice was observed. The initial reduction appeared to be tissue-specific and it is considered that damage to the intestinal epithelium assumes a major factor at the dose used. The amount of tissue exposed was a primary factor in determining the duration of the initial reduction. Differences in activity levels between *S* and *Ba* inbred mice, reciprocal F_1 males and females, and backcross male progenies implicated the sex chromosomes as a partial determinant of activity level, in addition to other factors which include total chromosome origin and degree of heterozygosity. The effects of whole-body irradiation on learning and learning retention of *K* mice produced a reduction of learning ability; in *Z* mice no reduction of learning ability was noted. Partial-body irradiation produced a decrement in the maze (modified-T-water) performance of

irradiated K mice but to a lesser degree in Z mice. The effects of x rays (320 and 2560 r) on mitotically active spermatogonial cells in mice were investigated. Irradiation produced a marked reduction in mitotic activity of Ba mice, the maximum being reached at 72 hr. The highest level observed was about 33 to 20% of that observed in unirradiated, partially hepatectomized mice. Comparable data which showed lower rates of mitoses were observed for S mice. Hybrid vigor, by increasing F_1 fertility threefold, increased the viabilities of eggs to x irradiation by one-third and reduced the apparent sterility of irradiated pairs of mice that were mated for life. Radiation effects on the delimitation of coat-pigment areas in mosaic mice were investigated. An experiment in which sterility was induced through irradiation mutation of a fertility gene is described. Studies on disease susceptibility induced by irradiations to different parts of the body and to the disease, that induced by Salmonella typhimurium in mice, are contained. Genotypic effects on life span of mice treated with x rays were studied. The role assumed by autosome IV in Drosophila melanogaster sex balance was investigated. (C.J.G.)

25241 UCRL-9235(p.3-16)

California. Univ., Berkeley. Lawrence Radiation Lab. A STUDY OF THE RADIOSENSITIVITY OF DRY PREPARATIONS OF LYSOZYME, TRYPSIN, AND DESOXYRIBONUCLEASE EXPOSED TO ACCELERATED NUCLEI OF HYDROGEN, HELIUM, CARBON, OXYGEN, AND NEON. Tor Brustad.

Results are reported from a study of the radiosensitivity of dry preparations of lysozyme, trypsin, and desoxyribonuclease exposed to accelerated nuclei of hydrogen, helium, carbon, oxygen, and neon. It was shown that the radiosensitivity of enzymes exposed in the dry state to ionizing radiation can be modified by the presence of foreign molecules, by varying the temperature during exposure, and by the presence or absence of oxygen. Reaction mechanisms involved are discussed. (C.H.)

25242 UCRL-9235(p.56-63)

California. Univ., Berkeley. Lawrence Radiation Lab. EFFECT OF ALPHA-PARTICLE HYPOPHYSECTOMY ON DISSEMINATED CANCER OF THE BREAST IN THE MALE. James L. Born, Piero E. Ariotti, Franco Sangalli, Richard C. Carlson, Paul Toch, John D. Constable, Cornelius A. Tobias, and John H. Lawrence.

Case histories are presented of two male patients with endocrine-dependent disseminated cancer of the breast which was treated with alpha-induced hypophysectomy. (C.H.)

25243 UR-574

Rochester, N. Y. Univ. Atomic Energy Project. RELATION OF ADRENAL CORTICAL VOLUME TO SURVIVAL FOLLOWING X-IRRADIATION. Alison P. Casarett and Franklin T. Brayer. June 16, 1960. 32p. Contract W-7401-eng-49. OTS.

Adrenalectomized rats and rats containing regenerating enucleated adrenals or homotransplanted adrenals were irradiated with 600 r of x rays. The volumes of regenerated adrenal cortical tissue were measured at various times after enucleation and these volumes were correlated with the 30-day lethality of adrenal enucleated rats irradiated at the same time period. The mortality rate was inversely related to the volume of adrenal cortical tissue. There was no statistically significant difference between survival of control animals and of animals irradiated six days after enucleation. At this time the regenerated adrenals contained about 45% of the control volume of ad-

renal cortical tissue. Corticosterone measurements from adrenal vein plasma suggested that a regenerating adrenal is capable of near-normal secretion of this steroid by six days post-enucleation. The relationship of corticosterone to survival is not known. (auth)

25244 AEC-tr-4110

THE EFFECT OF THE DECAY OF RADIOACTIVE PHOSPHORUS ON MUTATION OF GENES WHEN INCORPORATED INTO THE CELLS OF ESCHERICHIA COLI. (Mutagene Wirking des Zerfalles von Radioaktivem Phosphor Nach Einbau in Zellen von Escherichia Coli). F. Kaudewitz, W. Vielmetter, and H. Friedrich-Frekka. Translated from Z. Naturforsch. 13b, 793-802(1958). 14p. JCL.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 5265.

25245 JPRS-2546(p.1-5)

REMOTE SEQUELAE OF INJURY WITH RADIOACTIVE SUBSTANCES IN SMALL DOSES IN A CHRONIC EXPERIMENT. L. N. Burykina, D. I. Sakutinskiĭ (Sakutinskiy), N. A. Kraevskiĭ (Krayevskiy), E. B. Kurlyandskaya, N. N. Litvinov, Yu. I. Moskalev, A. P. Novikova, Yu. N. Solov'yev (Solov'yev), and V. N. Strel'tsova. Translated from Med. Radiol. 4, No. 3, 3-6(1959).

A review and comparison are made based on a number of studies carried out in an attempt to understand the biological effects of radioactive substances in small doses in animals. Three successive phases in radiation sickness are noted, and the effects on the hematopoietic system, the skeleton, the blood, and offspring are pointed out. (T.R.H.)

25246 JPRS-2546(p.17-23)

THE PROBLEM OF THE ROLE OF THE ADRENALS IN CERTAIN DISTURBANCES OF METABOLISM IN THE IRRADIATED ORGANISM. B. M. Graevskaya (Grayevskaya) and R. Ya. Kellina (Keylina). Translated from Med. Radiol. 4, No. 3, 21-5(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 14194.

25247 JPRS-2546(p.24-6)

THE EXCRETION OF BROMSULFALEIN AFTER X-IRRADIATION OF THE UPPER PORTION OF THE BODY IN MICE. M. Skalka. Translated from Med. Radiol. 4, No. 3, 25-6(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 14195.

25248 JPRS-2705(p.13-17)

THE INVESTIGATION OF RECEPTION OF IRRADIATED AREAS OF THE BODY IN EXPERIMENTS ON ANIMALS. N. S. Delitsyna. Translated from Med. Radiol. 4, No. 8, 17-20(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 20826.

25249 JPRS-2705(p.18-22)

VENOUS PRESSURE CHANGES IN ACUTE RADIATION SICKNESS IN RABBITS. A. S. Mozzhukhin. Translated from Med. Radiol. 4, No. 8, 21-3(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 20827.

25250 JPRS-2705(p.23-30)

THE COURSE OF THE EXUDATIVE PHASE OF INFLAM-

MATION IN IRRADIATED ANIMALS. E. R. Bagramyan. Translated from Med. Radiol. 4, No. 8, 23-8(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 20828.

25251 JPRS-2705(p.31-7)

STUDY OF THE ELECTRICAL PROPERTIES OF THE BLOOD BY THE HYDRATION METHOD AFTER RADIATION INJURY. Yu. Yu. Voronoi (Voronoy), A. T. Stovbun, and A. F. Kosenko. Translated from Med. Radiol. 4, No. 8, 28-32(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 20829.

25252 JPRS-2705(p.38-46)

OBTAINING DIPHTHERIA TOXIN IN MEDIA STERILIZED WITH GAMMA-RAYS. D. R. Kaulen. Translated from Med. Radiol. 4, No. 8, 49-54(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 20833.

25253 JPRS-2705(p.55-64)

THE CHANGE OF BLOOD GASES IN DOGS AFFECTED BY POLONIUM. G. I. Bezin. Translated from Med. Radiol. 4, No. 8, 60-6(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 20835.

25254 JPRS-2705(p.73-5)

MORPHOLOGICAL CHANGES IN THE PERIPHERAL WHITE BLOOD ELEMENT AFTER A TOTAL-BODY X-IRRADIATION IN COMBINATION WITH A WOUND OF THE KIDNEY. O. L. Tiktinskiĭ (Tiktinskiy). Translated from Med. Radiol. 4, No. 8, 81-2(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 20839.

25255 JPRS-2707(p.1-6)

THE EFFECT OF LOCAL IRRADIATION ON THE CONCENTRATION OF ACID-INSOLUBLE PHOSPHORUS FRACTIONS IN THE BONE MARROW OF RABBITS. V. S. Turovskiĭ (Turovskiy). Translated from Med. Radiol. 4, No. 10, 17-21(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 4242.

25256 JPRS-2707(p.7-13)

THE EFFECT OF THE ADRENOCORTICOTROPIC HORMONE OF THE HYPOPHYSIS AND SUPRARENAL CORTICAL EXTRACT ON HEMATOPOIESIS IN IRRADIATED ANIMALS. M. F. Aleksandrovich (Aleksandrova). Translated from Med. Radiol. 4, No. 10, 21-6(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 4261.

25257 JPRS-2707(p.14-19)

INVESTIGATION OF THE PROPERTIES OF IRRADIATED ERYTHROCYTES BY THE STRICTION METHOD. Yu. A. Kriger and E. (Ye) I. Yartsev. Translated from Med. Radiol. 4, No. 10, 26-30(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 4262.

25258 JPRS-2707(p.20-4)

BONE CHANGES IN THE POSTNATAL PERIOD IN THE OFFSPRING OF RABBITS EXPOSED TO THE EFFECT OF IONIZING RADIATION AT DIFFERENT PERIODS OF

GRAVIDITY. E. (Ye) I. Aleksandrovich. Translated from Med. Radiol. 4, No. 10, 30-4(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 4263.

25259 JPRS-2707(p.25-9)

EARLY AND LATE CHANGES IN THE SKELETAL MUSCULATURE OF RATS EXPOSED TO LOCAL X-IRRADIATION. T. N. Tuzhilkova. Translated from Med. Radiol. 4, 34-7 (1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 4243.

25260 JPRS-2707(p.36-43)

THE USE OF VITAMIN B₁₂ AND B₆ UNDER CONDITIONS OF THE REPEATED EFFECT OF X-RAYS. O. I. Belousova and E. K. Grabovenko. Translated from Med. Radiol. 4, No. 10, 41-6(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 4265.

25261 JPRS-2707(p.78-9)

THE EFFECT OF X-RAYS ON THE CONCENTRATION OF LACTIC ACID, ADENOSINETRIPHOSPHORIC ACID, CREATINE PHOSPHATE AND INORGANIC PHOSPHORUS IN THE BRAINS OF RATS. K. S. Kosyakov. Translated from Med. Radiol. 4, No. 10, 79-80(1959).

The biochemical composition of brain was investigated in rats exposed to x-ray doses of 500 to 900 r and in those with no exposure. Resulting data are presented tabularly. (J.R.D.)

25262 JPRS-2743(1-13)

PROBLEMS IN THE EXPERIMENTAL TECHNIQUE OF IRRADIATION AND CERTAIN RADIOBIOLOGICAL DATA. M. P. Domshlak, N. G. Darenskaya, L. B. Koznova, and V. G. Khrushchev. Translated from Med. Radiol. 4, No. 12, 3-11(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 6145.

25263 JPRS-2743(p.14-20)

CHANGES IN THE HIGHER NERVOUS ACTIVITY OF RATS DURING IRRADIATION OF THEM WITH ROENTGEN RAYS. I. S. Belokonski. Translated from Med. Radiol. 4, No. 12, 11-16(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 6146.

25264 JPRS-2743(p.29-35)

THE EFFECT OF X-IRRADIATION ON THE LEVEL OF NUCLEIC ACIDS IN THE LIVER AND SPLEEN OF RABBITS. L. Cheyka and Ya. Nosek. Translated from Med. Radiol. 4, No. 12, 21-4(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 6147.

25265 JPRS-2743(p.53-60)

THE MECHANISM OF THE DISTURBANCE IN THE ADRENALIN CONCENTRATION AND THE CONCENTRATION OF ADRENALIN-LIKE SUBSTANCES IN THE BLOOD AND IN THE AQUEOUS HUMOR OF THE EYE OF RABBITS AFTER A TOTAL-BODY IRRADIATION. A. F. Maslova. Translated from Med. Radiol. 4, No. 12, 36-41(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 6148.

25266 JPRS-2743(p.61-8)

THE SPECIES, ORGAN AND ORGANOID SPECIFICITY OF TISSUE ANTIGENS OF IRRADIATED ANIMALS. R. V.

Petrov and L. I. Il'ina (Il'yina). Translated from Med. Radiol. 4, No. 12, 41-7(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 6184.

25267 JPRS-2743(p.69-76)

COURSE OF EXPERIMENTAL TUBERCULOSIS UNDER CONDITIONS OF THE EFFECT OF IONIZING RADIATION. L. B. Aksel'rod, E. D. Duboviy (Ye. D. Dubovyy), N. D. Golban, A. A. Konshin, T. M. Tsitko, and E. P. Tsyban. Translated from Med. Radiol. 4, No. 12, 48-52(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 6149.

25268 JPRS-2743(p.77-87)

THE PROTECTIVE ROLE OF FOOD IN ACUTE RADIATION INJURY OF THE ORGANISM. S. R. Perepelkin and G. I. Bondarev. Translated from Med. Radiol. 4, No. 12, 53-8(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 6185.

25269 JPRS-2743(p.98-125)

THE DEVELOPMENT OF LEUKEMIAS UNDER THE INFLUENCE OF IONIZING RADIATION. V. N. Strel'tsova. Translated from Med. Radiol. 4, No. 12, 66-79(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 6150.

25270 JPRS-2743(p.128-30)

THE EFFECT OF X-RAYS ON THE ACTIVITY OF XANTHINE OXIDASE AND ALDEHYDE DEHYDROGENASE OF THE LIVER OF WHITE RATS. K. I. Pravdina and L. A. Tiunov. Translated from Med. Radiol. 4, No. 12, 81-2(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 6152.

25271 JPRS-5004

THE EFFECT OF IONIZING RADIATION ON THE LIPID COMPOSITION OF THE BLOOD AND LIVER OF THE RAT. V. V. Nikol'skii (Nikol'skiy), N. A. Nekovalyeva (Nekolayeva), and L. M. Chumakova. Translated from Ukrain. Biokhim. Zhur. 31, 877-82(1959). 8p. OTS.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 7266.

25272 JPRS-5016(p.11-30)

THE RESULTS OF DYNAMIC INVESTIGATION OF THE PERIPHERAL BLOOD IN PERSONS WHO HAVE WORKED FOR A LONG TIME WITH SMALL DOSES OF PENETRATING RADIATION. A. A. Danilin, N. I. Lukash, V. D. Serebryannikov, and G. A. Sheshina. Translated from Med. Radiol. 5, No. 4, 7-14(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 15562.

25273 JPRS-5016(p.43-54b)

DYNAMICS OF THE PHAGOCYTIC FUNCTION OF GRANULOCYTES IN DIFFERENT METHODS OF RADIATION THERAPY. A. S. Ozol. Translated from Med. Radiol. 5, No. 4, 19-23(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 15544.

25274 JPRS-5016(p.55-69)

CHANGE OF CEREBRAL CIRCULATION AFTER A

TOTAL-BODY IONIZING IRRADIATION OF AN ANIMAL. R. M. Lyubimova-Gerasimova. Translated from Med. Radiol. 5, No. 4, 24-9(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 15545.

25275 JPRS-5016(p.92-103)

THE EFFECT OF RADIATION ON THE VITAMIN B₁ METABOLISM. COMMUNICATION 2. CHANGES IN THE VITAMIN B CONTENT IN THE LIVER AND BRAIN. Iori (Yori) Ueno. Translated from Med. Radiol. 5, No. 4, 38-42(1960).

This paper was previously abstracted from the original language and appears in NSA, Volume 14, as abstract No. 15547.

25276 JPRS-5016(p.192-207)

RELATIONSHIP BETWEEN THE CHEMICAL STRUCTURE AND THE PROTECTIVE EFFECT OF VARIOUS MERCAPTOAMINES AGAINST X- AND γ -IRRADIATION. A. S. Mozhukhin, F. Yu. Rachinskii (Rachinskiy), and L. I. Tank. Translated from Med. Radiol. 5, No. 4, 78-81(1960).

More than 60 preparations were synthesized by substitutions in molecules of β -mercaptoethylamine and similar compounds. These compounds were studied to determine their protective effects against γ and x radiations. A lengthening of the carbon chain to more than three atoms of carbon led to a disappearance of the protective properties. The simultaneous substitution of hydrogen in the mercapto- and amino-groups also led to a loss of protective properties. No compounds were found which were more effective than mercamine. It was found that compounds containing only a single mercapto-group or a single amino-group possessed a weak protective effect. Doubling these groups did not produce any considerable increase in protective properties, but the combination of an amino-group or mercapto-group with other functional groups led to more pronounced protective properties. (M.C.G.)

25277 JPRS-5016(p.208-15)

THE SENSES OF TASTE AND SMELL IN PERSONS WORKING ON BETATRON. L. V. Kuznetsova. Translated from Med. Radiol. 5, No. 4, 82-4(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 15548.

25278 JPRS-5016(p.216-18)

CHANGE IN SKIN ALLERGY UNDER THE INFLUENCE OF X-RAYS WITH DORMANT GAS GANGRENE INFECTION. L. G. Kovtunovich. Translated from Med. Radiol. 5, No. 4, 85(1960).

Investigations indicated that in guinea pigs with foci of dormant gas gangrene infection exposed to irradiation in a dose of 500 r, a depression of skin allergy was always noted with the use of the specific *B. perfringens* allergen. A maximum depression of the allergic reaction was observed in 10 to 15 days after irradiation. All animals were injected with non-specific allergens on the opposite side. Pronounced skin reactions were not observed after the use of non-specific allergens in animals exposed to x rays. (M.C.G.)

25279 JPRS-5016(p.219-21)

THE EFFECT OF CERTAIN PROTECTIVE SUBSTANCES ON THE OXYGEN CONSUMPTION OF MUSCLE TISSUE OF RATS. E. (Ye.) F. Romantsev. Translated from Med. Radiol. 5, No. 4, 86(1960).

The nature of the reduction in O₂ consumption in animal tissues by injection of l-cysteine or β -mercaptoethylamine was investigated in a study of the protective effects of

these compounds against radiation. Rats were injected with a definite volume of air in the subcutaneous tissue. During the course of irradiation, no changes were found in O_2 consumption. In the next 20 min, a tendency toward a decrease in consumption was noted. After the administration of sodium cyanide, a tendency toward reduction in O_2 consumption was also noted. The administration of L-cysteine and β -mercaptoethylamine did not change the rate of O_2 consumption. (M.C.G.)

25280 JPRS-5016(p.224-7)

THE EFFECT OF SCREENING THE LIVER AREA ON THE SYNTHESIS OF ANTIBODIES AND THE INTERRELATIONSHIP OF PROTEIN FRACTIONS OF THE BLOOD SERUM. L. G. Prokopenko. Translated from Med. Radiol. 5, No. 4, 87(1960).

Experiments performed on 36 rabbits showed that the magnitude of agglutinin titers in rabbits that were given a total-body irradiation of 1000 r was $3\frac{1}{2}$ times less than in a control group. In animals in which the liver area was screened at the time of irradiation the quantity of agglutinins exceeded that in the control group. Protection of the liver area had no noticeable effect on the synthesis of precipitins. Screening the liver had a distinct protective effect on the synthesis of nonspecific γ globulins of the blood and prevented a reduction in albumin concentration. (M.C.G.)

25281 JPRS-5016(p.228-31)

THE EFFECT OF IONIZING RADIATION ON THE PERMEABILITY AND DISTRIBUTION OF RADIOACTIVE PHOSPHORUS IN THE TISSUES AND MEDIA OF THE EYE. N. I. Perelygin. Translated from Med. Radiol. 5, No. 4, 88(1960).

Investigation of the vascular permeability of the eye under the influence of total-body irradiation was carried out using P^{32} in the form of dibasic sodium phosphate. Five minutes after the injection of P^{32} into irradiated rabbits, a smaller than normal quantity had penetrated into the tissues of the eye. Subsequently, the quantity of P^{32} in the eye tissues became considerably greater in the irradiated animals than in those that had not been exposed. (M.C.G.)

25282 JPRS-5078(p.1-22)

SOME DATA CONCERNING THE MECHANISM OF RADIATION INJURY TO HEMATOPOIESIS. M. S. Lapteva-Popova and Yu. V. Venitskovskii-Zolotikh (Venitskovskiy-Zolotikh). Translated from Med. Radiol. 5, No. 2, 3-12 (1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 12475.

25283 JPRS-5078(p.23-36)

MATERIAL ON THE ANALYSIS OF CHANGES IN THE LEUKOCYTE REACTION IN RESPONSE TO STIMULATION OF GASTRIC MECHANORECEPTORS IN ANIMALS AFTER IRRADIATION. T. V. Tkacheva. Translated from Med. Radiol. 5, No. 2, 12-18(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 12476.

25284 JPRS-5078(p.37-45)

THE EFFECT OF L-CYSTEINE AND β -MERCAPTOETHYLAMINE ON THE OXYGEN CONTENT IN THE VENOUS BLOOD OF RATS. E. (Ye.) F. Romantsev. Translated from Med. Radiol. 5, No. 2, 19-21(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 12477.

25285 JPRS-5078(p.46-59)

ROENTGENOLOGICAL OBSERVATIONS IN EXPERIMEN-

TAL FRIEDLANDER'S PNEUMONIA IN IRRADIATED ANIMALS. R. M. Rabinovich. Translated from Med. Radiol. 5, No. 2, 22-5(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 12478.

25286 JPRS-5078(p.71-6)

THE EFFECT OF PROTECTIVE SUBSTANCES ON THE NUCLEIC ACID LEVEL IN THE ORGANS AFTER IRRADIATION. D. Milich and Ya. Nosek. Translated from Med. Radiol. 5, No. 2, 31-3(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 12480.

25287 JPRS-5078(p.85-97)

THE PERIPHERAL NERVOUS SYSTEM OF DOGS IN POLONIUM INJURY. B. I. Lebedev. Translated from Med. Radiol. 5, No. 2, 36-41(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 12509.

25288 JPRS-5078(p.98-109)

CHARACTERISTICS OF HEMATOPOIESIS IN RATS AND THEIR OFFSPRING AFTER THE EFFECT OF Sr^{90} . T. A. Ivanova. Translated from Med. Radiol. 5, No. 2, 41-5 (1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 12510.

25289 JPRS-5078(p.110-20)

MYOCARDIAL REACTIVITY TO CERTAIN PHARMACOLOGICAL AGENTS IN RABBITS INJURED BY POLONIUM (ACCORDING TO ELECTROCARDIOGRAPHIC DATA). B. B. Moroz and S. P. Grozdov. Translated from Med. Radiol. 5, No. 2, 46-50(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 12511.

25290 JPRS-5078(p.121-30)

CHANGES IN THE PROTEIN METABOLISM IN ANIMALS AFTER THE ADMINISTRATION OF RADIOACTIVE PHOSPHORUS. I. V. Savitskiĭ (Savitskiy). Translated from Med. Radiol. 5, No. 2, 50-4(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 12431.

25291 JPRS-5124(p.1-12)

CERTAIN CHARACTERISTICS OF THE DEVELOPMENT OF RADIATION INJURY IN DOGS FROM CHRONIC IRRADIATION WITH Sr^{90} . E. (Ye.) N. Klimova and O. G. Alekseeva (Alekseyeva). Translated from Med. Radiol. 5, No. 3, 3-7(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 13610.

25292 JPRS-5124(p.13-28)

HEMATOPOIESIS IN THE OFFSPRING OF RATS EXPOSED TO THE EFFECT OF Sr^{90} . T. A. Ivanova. Translated from Med. Radiol. 5, No. 3, 8-13(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 13611.

25293 JPRS-5124(p.29-41)

MORPHOGENESIS OF BONE TUMORS OCCURRING UNDER THE INFLUENCE OF PENETRATING RADIATION. B. M. Nikitin. Translated from Med. Radiol. 5, No. 3, 13-18 (1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 13612.

25294 JPRS-5124(p.42-57)

CHANGES IN THE LUNGS DURING RADIATION THERAPY OF CARCINOMA OF THE ESOPHAGUS (CLINICORADIOLOGICAL OBSERVATIONS). T. A. Tretyakova. Translated from Med. Radiol. 5, No. 3, 19-23(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 13613.

25295 JPRS-5124(p.58-66)

LATE COMPLICATION AFTER THE DIAGNOSTIC USE OF A LONG-LIVED RADIOACTIVE SUBSTANCE (THORIUM). F. M. Lyass. Translated from Med. Radiol. 5, No. 3, 23-6(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 13614.

25296 JPRS-5124(p.67-78)

THE EFFECT OF RADIATION ON THE VITAMIN B₁ METABOLISM. COMMUNICATION 1. CHANGE IN THE VITAMIN B₁ CONTENT IN THE BLOOD AND ITS EXCRETION IN THE URINE. Iori (Yori) Ueno. Translated from Med. Radiol. 5, No. 3, 27-31(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 13615.

25297 JPRS-5124(p.97-109)

THE EXCRETION OF DESOXYCYTIDIN FROM THE BODY UNDER DIFFERENT IRRADIATION CONDITIONS. Z. I. Zhulanova and E. (Ye.) F. Romantsev. Translated from Med. Radiol. 5, No. 3, 39-43(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 13616.

25293 JPRS-5124(p.175-9)

THE EFFECT OF X-IRRADIATION ON THE REACTIVITY OF ANIMALS AFTER THE INJECTION OF STROPHANTHIN. A. V. Lazovskaya. Translated from Med. Radiol. 5, No. 3, 71-2(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 13617.

25299 JPRS-5124(p.180-2)

THE CHANGE IN THE REACTIVITY OF THE STOMACH IN DOGS AFTER REPEATED TOTAL-BODY IRRADIATION. K. A. Grineva. Translated from Med. Radiol. 5, No. 3, 72(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 13618.

25300 JPRS-5124(p.183-6)

SOME DATA ON THE MECHANISM OF "CONSERVATION" OF THE RADIATION EFFECT IN THE CORNEAL EPITHELIUM OF THE FROG UNDER HIBERNATION CONDITIONS. I. B. Bychkovskaya. Translated from Med. Radiol. 5, No. 3, 73(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 13619.

25301 JPRS-5327

EFFECT OF VITAMIN B₁ ON THE ORGANISM OF ANIMALS SUBJECTED TO THE ACTION OF IONIZING RADIATION. A. F. Leshchinskii (Leshchinskiy) and A. N. Borisenko. Translated from Farmakol. i. Toksikol. 23, No. 2, 169-73(1960). 8p. OTS.

A study was made of the effects of pharmacologically active doses of vitamin B₁ on whole-body x-irradiated animals over a period of 1 to 1½ months. Guinea pigs, rabbits, and white mice were exposed to doses of 100, 725, and 500 r, respectively. It was found that the vitamin B₁ did not exert a desensitizing effect on anaphylactized previously-irradiated animals. A separate administration of vitamin B₁ and x rays inhibits development of anaphylactic shock. Administration of thiamine bromide to irradiated animals aggravates the general condition and leads to higher death rates. reduction of cholinesterase activity in the blood, increase of leukopenia. and changes in the leucocytary formula. (T.R.H.)

25302 JPRS-5403(p.170-1)

THE INFLUENCE OF PENETRATING RADIATION ON THE POST-TRAUMATIC REGENERATION OF SKELETAL MUSCLE AND THE EPIDERMIS. N. V. Kozlova. Translated from Med. Radiol. 5, No. 5, 75(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 20099.

25303 JPRS-5403(p.172-4)

THE CONDITION OF THE HISTOHEMATIC BARRIERS IN THE OFFSPRING OF IRRADIATED ANIMALS. V. A. Tats'evskii (Tatsiyevskiy). Translated from Med. Radiol. 5, No. 5, 75-6(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 20100.

25304 JPRS-5403(p.175-7)

THE INFLUENCE OF X-RAYS ON THE CATALASE ACTIVITY IN THE BRAINS OF MICE. K. S. Kosyakov. Med. Radiol. 5, No. 5, 76-7(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 20101.

25305 JPRS-5464

THE CONTENT OF ADRENOCORTICOTROPIC HORMONE (ACTH) IN THE ADENOHYPOPHYSES OF CONTROL AND IRRADIATED RATS. (Soderzhaniye Adrenokortikotropnogo Gormona (AKTG) v Adenogipofizakh Kontrol'nykh i Obluchennykh Krys). M. A. Larina. Translated from Problemy Endokrinol. i. Gormonoterap. 6, No. 3, 18-21(1960). 10p. OTS.

A study was made of the ACTH content in the pituitary of rats 3 hr after whole-body irradiation with a minimum lethal dose of x rays. The rats received 700 r at 38 r/sec in a RUM-11 apparatus. The weight of the pituitary remained normal; the ACTH content of the anterior lobe was slightly lower than in the normal rat. (T.R.H.)

25306 JPRS-5465

THE ROLE OF THE HYPOPHYSIS AND ADRENALS IN THE REGULATION OF SYSTOLIC BLOOD PRESSURE IN IRRADIATED RATS. (Rol' Gipofiza i Nadpochechnikov v Regulatsii Sistolicheskogo Krovyanogo Davleniya u Obluchennykh Krys). A. A. Grafov. Translated from Problemy Endokrinol. i. Gormonoterap. 6, No. 3, 22-6(1960). 10p. OTS.

The role of the pituitary and the adrenal glands in radiation hypotension was studied. Doses of 100, 300, and 600 r were administered in a RUM-3 apparatus (at about 30 r/min) to a total of 110 adult, intact, adrenalectomized and hypophysectomized rats. The results showed an absence of blood-pressure regulation in radiation sickness, indicating the regulatory function of these glands. The drop in blood pressure in hypophysectomized rats irradiated to 100 r corresponds roughly to the drop in unoperated rats

with a dose of 600 r. In adrenalectomized rats with a dose of 100 r the blood pressure declines to that of unoperated rats with 300 r. The systolic pressure changes inversely with general radiosensitivity which rises less rapidly in operated rats. (T.R.H.)

25307 JPRS-5466

THE EFFECT OF IONIZING RADIATIONS ON THE ADRENOCORTICOTROPIC ACTIVITY OF THE PERIPHERAL BLOOD OF RATS. (Vliyaniye Ioniziruyushchey Radiatsii na Adrenokortikotropnuyt Aktivnost' Perifericheskoy Krovi Krysa). E. R. Bagramyan. Translated from *Promlemy Endokrinol. i Gormonterap.* 6, No. 3, 27-31 (1960). 11p. OTS.

The Brodich and Long crossed-circulation technique was used in a study of radiation effects on ACTH activity of peripheral blood in rats. Blood of the experimental animal is diverted from its femoral artery to the femoral vein of a hypophysectomized rat, and back again. One adrenal gland of the hypophysectomized rat was removed before and after the experiment and analyzed for ascorbic acid. The difference in ascorbic acid represent ACTH activity. The ACTH in 12 ml of normal blood reduced the ascorbic acid content 12.8%. Acute blood loss or stimulation of a nerve increased ACTH activity in peripheral blood. Three hours post-irradiation the ACTH activity is considerably reduced and after 5 hr no ACTH can be detected. (T.R.H.)

25308

RADIATION-INDUCED LEAF SPOT RESISTANT MUTANTS IN THE PEANUT (*ARACHIS HYPOGAEA* L.). W. E. Cooper and W. C. Gregory (North Carolina State Coll., Raleigh). *Agron. J.* 52, 1-4(1960).

Peanut seed irradiated with 10,000 to 18,500 r x rays produced X_2 and X_3 progenies with both decreased and increased resistance to leaf spot. Selected entries compared in following generations showed highly significant differences in number and relative frequency of specific leaf spot lesions, numbers of leaves not defoliated, and in entry defoliation x disease control. Leaf spot resistant lines were developed by selecting for defoliation resistance in X_2 and X_3 generations, followed by quantitative evaluation in later generations. (auth)

25309

EFFECT OF AET ON SODIUM, POTASSIUM AND ESTERASES OF THE ALIMENTARY TRACT OF IRRADIATED MICE. Jean R. Maisin and Raymond A. Popp (Oak Ridge National Lab., Tenn.). *Am. J. Physiol.* 199, 251-5(1960) Aug.

A study was made of the effect of S, 2-aminoethylisothiuronium bromide hydrobromide (AET) on the changes in sodium and potassium concentrations in the walls and contents of the gastrointestinal tracts of mice exposed to 1500 r. Mice were given AET and then irradiated. At intervals thereafter, portions of the gastrointestinal tract and its contents were analyzed for sodium and potassium in a flame spectrophotometer. In mice given AET before exposure to 1500 r, the following radiation-induced abnormalities were completely or partially corrected: decrease in potassium and increase in sodium in the wall of the small intestine; decrease in potassium in the colon wall; and increase in sodium and potassium in the contents of the stomach, small intestine and colon. Extracts from the walls of the small intestines of AET-treated or nontreated, irradiated mice were analyzed chemically for esterase activity. In AET-treated, irradiated mice, complete recovery of esterase activity was observed by day 7 after 900 r; and partial recovery occurred after 1500 r. Since AET reduces radiation damage and thereby allows recovery, the benefi-

cial effects of the compound on the correction of electrolyte imbalance and esterase activity are ascribed to recovery of the tissues of the gastrointestinal tract. (auth)

25310

EFFECT OF THE DESTRUCTION OF HYPOTHALAMUS ON THE SUPRARENAL RESPONSE OF THE RAT TO TOTAL BODY IRRADIATION. Z. M. Bacq, P. G. Smelik, M. Goutier-Pirotte, and J. Renon (Université, Liège; Université, Groningen, Netherlands; Laboratoire de Recherche pour la Protection des Populations Civiles, Liège; and Centre National de Radiobiologie et de Génétique). *Brit. J. Radiol.* 33, 618-21(1960) Oct.

In the adult rat irradiated 2 days after the destruction of the hypothalamus, the early reversible reaction of the suprarenals to a total-body dose of 850 r of 200 kv x rays is abolished and no drop in ascorbic acid and cholesterol content is observed. This fact confirms the important part played by the central nervous system in the neuro-endocrine reaction following severe irradiation. It is difficult to avoid the conclusion that the most sensitive tissue from which the reaction starts is the central nervous system. Our observations do not bring any new fact which could help in the interpretation of the mechanism and meaning of the late suprarenal reaction which begins 2 days after irradiation and continues until death. (auth)

25311

EFFECT OF X RAYS ON THE UPTAKE OF PHOSPHORUS 32 BY THE MOUSE KNEE JOINT. DEPENDENCE UPON THE SPACING INTERVAL OF THE EFFECT PRODUCED BY TWO SPACED EQUAL DOSE FRACTIONS. C. W. Wilson (Westminster Hospital, London). *Brit. J. Radiol.* 33, 636-9(1960) Oct.

The depression of uptake of P^{32} in the mouse knee joint produced by two separate x-ray dose fractions delivered with a range of intervals between them is compared with that produced by a single dose equal to the sum of the fractions. It is found that the effect due to the two doses is only a fraction of the effect due to the single dose and this fraction decreases as the interval between the two doses increases from zero to about 5 or 6 hr. For intervals between the two doses ranging from 5 or 6 hr to 1 week there is no change in the fraction. An attempt is made to explain these results which are also correlated with the observations of others with a view to emphasizing the dynamic character of the events that may follow irradiation of a complex tissue. (auth)

25312

INHIBITION OF MALIGNANT CELL GROWTH AND SPREAD BY COMBINED INTERNAL (TOPICAL) AND EXTERNAL (SYSTEMIC) IRRADIATIONS. Horace Goldie, Gadson J. Tarleton, Odis Strong, and Lonnie D. Deaderick (Meharry Medical Coll., Nashville). *Cancer Research* 20, 1324-8(1960) Oct.

Growth of Krebs-2 free tumor cells in the ascitic fluid of the mouse (CFW or albino) and their spread and implantation into peritoneal tissues were considerably reduced either by total-body irradiation (external and systemic) with 400 r or by intraperitoneal injection of 0.15 mc of colloidal radioactive chromic phosphate (internal and topical irradiation). Combined irradiations given in either succession completely prevented (or very nearly so) invasion of the fluid accumulation. Similarly, growth and spread of tumor cell inoculated subcutaneously into the scalp were arrested partially by either method of irradiation and totally by their combination. Analogous phenomena were produced in some normal tissues: in normal mice given 0.15 mc isotope into the scalp the spleen was enlarged by

congestion; in irradiated (400 r) mice, it was slightly shrunk, and considerably shrunk after combined irradiation. It was concluded that the effect of internal (topical) irradiation on tumor cells and on blood vessels was considerably increased by combination with external (systemic) irradiation or vice versa. (auth)

25313

THE EFFECTS OF CHRONIC IRRADIATION ON DNA SYNTHESIS IN REGENERATING MOUSE LIVER. S. Leshner, A. N. Stroud, and A. M. Brues (Argonne National Lab., Ill.). *Cancer Research* 20, 1341-6(1960) Oct.

The rate at which liver cells synthesize desoxyribonucleic acid (DNA) and divide following partial hepatectomy has been studied in LAF₁ mice exposed to 12 r per day of Co⁶⁰ gamma irradiation for 350 days starting at 100 days of age and two nonirradiated groups of 120 and 450 days of age. The amount of DNA per individual nucleus was determined photometrically in Feulgen-stained preparations. The incorporation of tritiated thymidine into parenchymal liver nuclei at various time intervals after partial hepatectomy was used as a measure of DNA synthesis. DNA synthesis and cell division decrease with age and are further decreased by extended exposure to daily low-dose γ irradiation. The data suggest that although chronic irradiation delays the onset of DNA synthesis to some extent it inhibits it only to a limited degree. It also interferes with cell division, possibly owing to accumulated chromosome damage; increased ploidy of liver cells in the previously irradiated animals may be accounted for by this. (auth)

25314

DEPENDENCE OF THE METHOD OF PRESERVATION AFTER IRRADIATION AND OF THE RADIOLESIONS PRODUCED IN GRAINS OF DRIED BARLEY. Michel-Armand Sicard and Drew Schwartz (Oak Ridge National Lab., Tenn.). *Compt. rend.* 251, 897-9(1960) Aug. 8. (In French)

The radiosensitivity of dried grains is not modified by preservation after irradiation if the water content of these grains is kept constant. A slow rehumidification of very dry grains at the moment of the irradiation causes a restoration. (tr-auth)

25315

EFFECT OF X IRRADIATION OF THE RAT LIVER ON THE PRODUCTION OF HEPATOME BY INTOXICATION WITH PARA-DIMETHYLAMINOAZOBENZENE. Antoine Lacassagne, Lucienne Hurst, and Albert-Jean Rosenberg. *Compt. rend.* 251, 1053-5(1960) Aug. 29. (In French)

A study is made of the x-radiation-induced modifications to the morphological changes produced by chronic poisoning with p-dimethylaminoazobenzene. A single strong dose of x radiation was used on one-half of the liver. In this way each liver is its own control. The administration of the poison was started only after complete restoration of the samples. In the experimental conditions, x radiation delayed the cancerization processes caused by the administration of p-dimethylaminoazobenzene. In animals receiving reserpine this delay was not noticed. (J.S.R.)

25316

AN EXPERIMENTAL ANALYSIS OF THE INITIAL MECHANISM RESPONSIBLE FOR THE EFFECT OF RADIATION ON THE CELL NUCLEUS. N. P. Dubinin, B. N. Sidorov, and N. N. Sokolov (Inst. of Biophysics, Academy of Sciences, USSR). *Doklady Akad. Nauk S.S.S.R.* 133, 221-4 (1960) July 1. (In Russian)

Physical and chemical data indicate primary radiation effects induced by energy absorption within the molecule (the direct action) or by the indirect action of free-radical

formation in ionization. An analysis was made of both the direct and indirect action to find some means of chemical protection from OH⁻ in regenerating systems. Experiments with bromine and iodine ions introduced into onion root cells (for 10 min with 0.06M KI or KBr solution) showed a considerable depressing effect for Fenton reagent (0.001M FeSO₄ for 60 min + 0.01M H₂O₂ for 60 min) and for an ascorbic acid mixture (0.001M for 60 min + 0.01M H₂O₂ for 60 min). A saturating amount of hydrogen peroxide, inducing chromosome changes, was introduced into the reaction. Iodine ions did not protect the chromosomes against hydrogen peroxide; the Fenton reagent was more genetically effective. Ascorbic acid (as free-radical acceptor) can protect the chromosomes. The data show that ionizing radiation has a direct effect on the chromosomes and other macromolecular cell structures, but the direct effect can be altered by cell metabolism or chromosome structure. It was found that iodine, bromine, and other chemicals actively protect the chromosomes from free radicals prepared by chemical methods and do not influence radiation genetics. (R.V.J.)

25317

HISTOCHEMICAL TESTS OF DISCOVERY OF FAT PEROXIDES IN THE EPIDERMIS OF RATS IN LOCAL IRRADIATION. Henryk Godlewski. *Folia Morphol.* 9, 35-8(1958). (Translated from *Referat. Zhur. Biol.* No. 4, 1959, abstract No. 18069).

Fat peroxides were determined according to the method of Dubulo and Duma 0, 3, 6, and 24 hr after single local irradiation of the hip with a dose of 2400 r. Negative results were obtained. However, the peroxides were discovered in irradiated as well as in control animals in places of prolonged restorative degeneration of unknown etiology (panniculus carnosus?).

25318

CHANGES IN THE RELATIVE CONTENT OF NUCLEIC ACIDS IN THE EPIDERMIS OF RATS IN LOCAL IRRADIATION. Krzysztof Vorbrodt, Henryk Godlewski, and Anna Dux. *Folia Morphol.* 9, 39-48(1958). (Translated from *Referat. Zhur. Biol.* No. 4, 1959, abstract No. 18070).

With the contact apparatus of Sholl, the skin of the hip of white rats was irradiated, and the intensity was studied of histochemical reactions to nucleic acids after 3, 6, and 24 hr. Desoxyribose nucleic acid was determined according to the method of Felgen; ribonucleic acid according to the method of Brashe. The intensity of reactions was determined microphotometrically; the intensity of metachromasy β by means of metachromatic index. Immediately after irradiation, the decrease of reactions to nucleic acids was noted; in subsequent hours a return to control values.

25319

THE INFLUENCE OF LOCAL X-RAY IRRADIATION ON THE DISTRIBUTION AND ACTIVITY OF PHOSPHATASES IN THE EPIDERMIS OF RAT. Zbigniew Bankowski and Andrzej Vorbrodt. *Folia Morphol.* 9, 49-52(1958). (Translated from *Referat. Zhur. Biol.* No. 4, 1959, abstract No. 18076).

The distribution of activity of basic phosphatase(I), 5-nucleotidase(II), acid phosphatase(III), and ATP(IV) was investigated. No changes of activity of I and II after irradiation were noted. The reaction to III was stable (in places weak, in places similar to the reaction of control animals). Activity of IV in the nuclei of basic layers of epidermis was decreased 3, 6, and 24 hr after irradiation.

25320

THE DETERMINATION OF THE CONTENT OF SULF-

HYDRYL GROUPS IN THE LIVER OF RATS AFTER LOCAL SKIN IRRADIATION. Tadeusz Patzek. *Folia Morphol.* 9, 55-6(1958). (Translated from *Referat. Zhur. Biol.* No. 4, 1959, abstract No. 18073).

A modified method of Flesh and Cuhn was used. In the course of 24 hr after a single irradiation at 2400 r, no changes in the content of SH-groups in the liver were discovered.

25321

EARLY CHANGES OF THE HISTOCHEMICAL REACTION OF SH-GROUPS AND TO S-S CONNECTIONS IN THE EPIDERMIS OF RATS AFTER IRRADIATION. Zbigniew Bankowski and Krzysztof Vorbrodt. *Folia Morphol.* 9, 57-61(1958). (Translated from *Referat. Zhur. Biol.* No. 4, 1959, abstract No. 18074).

In the skin of rats immediately after irradiation with 2400 r, a clear decrease of the content of SH-groups and an increase of connections S-S were noted. It is assumed that under the influence of irradiation, SH-groups turn out to be oxidized to the S-S connection.

25322

FURTHER INVESTIGATIONS OF THE INFLUENCE OF X-RAYS ON THE CONTENT AND DISTRIBUTION OF SH-GROUPS AND S-S CONNECTIONS IN THE EPIDERMIS OF MICE. Zbigniew Bankowski. *Folia Morphol.* 9, 63-8 (1958). (Translated from *Referat. Zhur. Biol.* No. 4, 1959, abstract No. 18075).

After local irradiation with 1600 r, the content in the epidermis of SH-groups decreased and the amount of S-S-connections increased. The maximum effect took place 3 hr after irradiation.

25323

SYNTHESIS OF CREATINE IN X-IRRADIATED RATS. M. K. Nerurkar and M. B. Sahasrabudhe (Atomic Energy Establishment, Trombay, India and Indian Cancer Research Centre, Bombay). *Intern. J. Radiation Biol.* 2, 237-46 (1960) July. (In English)

Synthesis and excretion of creatine and creatinine in total-body x-irradiated (600 r) rats were investigated. Irradiated rats exhibited a marked creatinuria, whereas creatinine excretion was only slightly increased in comparison to that of non-irradiated control animals. The increased creatine excretion after irradiation was ascribed to accelerated synthesis in the liver and greater release from the muscle. *In vitro* studies on the synthesis of creatine in liver homogenates revealed that the synthetic activity decreased immediately after irradiation but at later intervals showed a marked rise. The immediate fall in the creatine synthesis was not due to decreased availability of ATP or glutathione. Administration of nicotinamide to animals, to inhibit the new creatine synthesis in the liver, indicated that although the creatine formation in the liver of x-irradiated rats was elevated, it could not account for more than a small fraction of the creatinuria observed. Most of the urinary creatine originated from the muscle, probably because of the impaired reconversion of creatine to phosphocreatine. Since the muscle ATP-creatine transphosphorylase activity was not affected by irradiation, it is suggested that the mobilization of muscle creatine to cause creatinuria is probably due to the diminution of glycolysis in the muscle of irradiated animals. (auth)

25324

CHANGES IN THE RADIOSENSITIVITY OF THE TESTIS DURING FOETAL DEVELOPMENT. Heather M. Beaumont (Univ. of Birmingham, Eng.). *Intern. J. Radiation Biol.* 2, 247-56(1960) July. (In English)

Pregnant rats were anesthetized and exposed to doses

of 25 to 2×100 r at varying times between the 13th and the 20th days of gestation, the beam being focused on the abdominal wall. The does were then allowed to give birth, and the young were killed at the age of 25 days. A quantitative histological study of the testes showed that there was a curvilinear relationship between the proportion of seminiferous tubules classified as normal and sterile, the dose to which the animals were exposed, and fetal age at the time of exposure. (auth)

25325

EFFECT OF GIBBERELIC ACID ON THE RADIATION-STUNTED SEEDLINGS OF MAIZE. B. K. Gaur and N. K. Natani (Atomic Energy Establishment, Trombay, India). *Intern. J. Radiation Biol.* 2, 257-9(1960) July. (In English)

Maize seed of the single cross WF 9 \times 38-11 were irradiated with pile neutrons with doses ranging from 1×10^{12} Np to 5×10^{14} Np and then treated with gibberellic acid (GA). In one set of experiments the seed were soaked in GA for 24 hr and raised in sand. In another set they were sprouted in water, and seedlings with a 2 to 3 cm root-length from this set were grown in GA solution. It was evident from both these experiments that GA can reverse the stunting of seedlings caused by radiation. (auth)

25326

THE INFLUENCE OF OXYGEN AND TEMPERATURE ON THE RADIOSENSITIVITY OF SOAKED BARLEY SEEDS. D. Roy Davies and E. T. Wall (Wantage Radiation Lab., Harwell, Berks, Eng.). *Intern. J. Radiation Biol.* 2, 261-7 (1960) July. (In English)

The radiosensitivity of soaked barley seeds was found to be directly dependent on their stage of development in relation to the cell cycle. At any given stage of development there was a pronounced oxygen effect but no effect of irradiation temperature at 2 to 20°C. There was no evidence of any temperature-dependent recovery process. Similar responses were obtained when radiobiological damage was measured in terms of induced mutation, sterility, or growth inhibition. (auth)

25327

BIOCHEMICAL CHANGES IN TUMOR CELLS AFTER TREATMENT WITH X RAYS, IODOACETATE, HYDROGEN PEROXIDE, AND ETHYLENIMINO-BENZOQUINONE. H. Maass and H. A. Künkel (Universitäts-Frauenklinik, Hamburg). *Intern. J. Radiation Biol.* 2, 269-79(1960) July. (In German)

Results are reported from biochemical investigations on tumor cells after treatment with various physical and chemical agents. If the effects of x rays, iodo-acetate, H_2O_2 , and several ethyleneimino-benzoquinones on the carbohydrate metabolism are compared, very similar mechanisms of action are observed. These four agents inhibit the dehydrogenation of triosephosphate; but in the case of iodo-acetate, an inactivation of triosephosphatedehydrogenase seems to be the reason for this inhibition. In irradiated cells, however, this enzyme is not inactivated, the delay of dehydrogenation being caused mainly by a loss of DPN. After application of cytostatic agents and H_2O_2 , a similar mechanism can be suggested although both agents are also able to block this enzyme. On the other hand, the reaction of the DNA-synthesis is different. Here a much greater sensitivity to x rays and to cytostatic agents than in the case of glycolysis is observed. Iodo-acetate, however, inhibits DNA-synthesis in the same range of concentrations in which the glycolysis is blocked. (auth)

25328

CHEMICAL PROTECTION OF THE ALIMENTARY TRACT OF WHOLE-BODY X-IRRADIATED MICE. 1. CHANGES

IN WEIGHT, HISTOLOGY, AND CELL DIVISION IN RELATION TO NUCLEIC ACID AND PROTEIN SYNTHESIS.

Jean R. Maisin, G. D. Novelli, D. G. Doherty, and C. C. Congdon (Oak Ridge National Lab., Tenn.). *Intern. J. Radiation Biol.* 2, 281-93(1960) July. (In English)

Chemical protection afforded by AET to the alimentary tracts of mice against radiation doses of 900, 1500, and 2000 r was studied. Although the small intestine was studied most intensively, data were also collected on the esophagus, stomach, caecum and colon. For all measurements AET-treated mice were compared with nontreated mice and normal controls. The weights of organs and their contents were measured separately. Histological evaluation was made throughout the radiation injury and recovery period. Mitotic counts were obtained on the histologic sections of the alimentary tracts. Chemical analyses, including DNA-, RNA-, and protein-synthesis were performed on the small intestine at the 1500-r exposure level only. All measurements demonstrated a marked protective action of AET on the alimentary tract at these radiation exposure doses. (auth)

25329

VARIATION OF ACUTE MORTALITY WITH DOSE-RATE IN MICE EXPOSED TO SINGLE LARGE DOSES OF WHOLE-BODY X-RADIATION. F. E. Neal (Medical Research Council, Harwell, Berks, Eng.). *Intern. J. Radiation Biol.* 2, 295-300(1960) July. (In English)

As the duration of a continuous exposure to radiation of mice was increased from 1 min to 8 hr and the dose-rate of the radiation exposure correspondingly reduced, there was a progressive increase in the value of the median lethal dose for deaths within 30 days. There was a small qualitative difference attributable to dose-rate in deaths occurring up to 30 days after irradiation. In the animals given the longest exposures, there were fewer deaths before 10 days than in the other groups. Deaths with a severe gastrointestinal syndrome occurring between 30 and 200 days after irradiation were much more frequent in mice irradiated at 68 rads/min than in mice irradiated at lower dose-rates. (auth)

25330

THE MECHANISM OF X-RAY INACTIVATION OF PHOSPHOGLYCERALDEHYDE DEHYDROGENASE. Rolf Lange and Alexander Pihl (Norsk Hydro's Inst. for Cancer Research, Oslo). *Intern. J. Radiation Biol.* 2, 301-8(1960) July. (In English)

The x ray inactivation of crystalline rabbit-muscle phosphoglycerdehyde dehydrogenase (GAPDH) in solution was correlated with the concurrent radiochemical destruction of enzyme SH-groups. The inactivation was found to be directly proportional to the disappearance of enzyme SH-groups and was complete when three SH-groups were destroyed. Exactly the same relationship between enzyme inactivation and disappearance of free SH-groups was found when an increasing number of SH-groups were blocked by the addition of p-chloromercuribenzoate. The data strongly indicate that the x-ray inactivation of GAPDH can be entirely accounted for by destruction of its SH-groups. The G-value for the x-ray destruction of the enzyme SH-groups was found to be 0.23, indicating that the major part of the radiation energy is dissipated in processes not involving the protein SH-groups. Blocking of enzyme SH-groups by p-chloromercuribenzoate prior to the irradiation provided partial protection of the enzyme. The data are consistent with the view that, contrary to current assumptions, all SH-groups of GAPDH are of importance for the enzyme activity. (auth)

25331

FILAMENTOUS GREEN ALGAE FOR RADIOBIOLOGICAL STUDY. Alma Howard and R. J. Horsley (Mount Vernon Hospital, Northwood, Middx., Eng.). *Intern. J. Radiation Biol.* 2, 319-30(1960) July. (In English)

Young sporelings of the fresh-water green alga *Oedogonium cardiacum* are well suited to studies of the effects of irradiation on cell proliferation. The motile zoospores give rise to unbranched filaments of large uninucleate cells. Spores lose their ability to produce viable daughter cells after lower x-ray doses than were found necessary to produce similar effects in some other green algae. (auth)

25332

EFFECT OF WHOLE-BODY RADIATION *IN VIVO* ON THE DNA OF RAT LIVER. J. A. V. Butler and D. J. R. Lawrence (Royal Cancer Hospital, London). *Intern. J. Radiation Biol.* 2, 331-2(1960) July. (In English)

The pH of the salt solution used in the washing of nucleoprotein materials was found to affect the yield of desoxyribonucleic acid (DNA). The effect of variations of the conditions on results from studies on the effect of whole-body irradiation *in vivo* on the DNA content of rat liver is discussed. (C.H.)

25333

BACKGROUND RADIATION AS THE CAUSE OF FATAL CONGENITAL MALFORMATION. J. P. Wesley (Univ. of California, Livermore). *Intern. J. Radiation Biol.* 2, 333-4(1960) July. (In English)

Evidence is presented that indicates that background radiation is responsible for some fatal human congenital malformations. The reliability of existing medical statistics is discussed. (C.H.)

25334

HEPATIC, MICROVASCULAR MODIFICATIONS INDUCED BY IRRADIATION WITH GAMMA RAYS FROM RADIUM AND OBSERVED *IN VIVO* BY TRANSILLUMINATION. C. Piovella, G. F. Mazzoleni, and A. de Silvestri (Università, Pavia, Italy). *Minerva nucleare* 4, 202-7(1960) July-Aug. (In Italian)

Gamma-ray irradiation with radium of the liver in rats and frogs, observed *in vivo* by means of transillumination, caused intense and early selective venulo-sinusoidal vasodilatation in the irradiated areas. The most common circulatory changes observed consisted in the opening of arteriolo-portal anastomoses with inversion of the blood flow, sinusoidal stasis with diapedesis of red blood cells, or strictly localized microhemorrhages. The effects of irradiation were proportionate with the intensity of the stimulus, reversible with low doses, and constant in all the animals observed although individual differences in the vasculodynamic response were noted. (auth)

25335

SERUM ENZYMES IN THE COURSE OF THERAPY WITH CONVENTIONAL AND BETATRON RADIATION. R. Cattaneo, C. Prinotti, and G. Rigazio (Università, Turin). *Minerva nucleare* 4, 207-16(1960) July-Aug. (In Italian)

The serum glutamic-oxaloacetic transaminase, lactic dehydrogenase, and phosphoglucose isomerase were determined before, during, and after irradiation in 27 patients, mostly with tumoral diseases, who were treated with conventional roentgen therapy (11 cases) or betatron therapy (16 cases). During treatment variations of the glutamic-oxaloacetic transaminase occurred in 12 cases (44%); variations of the lactic dehydrogenase occurred in 26 cases (96%); and variation of the phosphoglucose isomerase occurred in 18 cases (66%). These variations consisted in an increase of normal values to pathologic levels, in a decrease of patho-

logic values to normal levels, in irregular variations during the course of treatment, or in appreciable variations of the values at permanently increased levels. These variations showed no clear relation with the type of disease or with the clinical course of the disease during irradiation. The enzymatic activities considered varied more frequently in patients treated with conventional irradiation therapy than in those receiving betatron therapy. (auth)

25336

DYE-SENSITIZED PHOTO-REACTIVATION OF X-RAY DAMAGE IN DIPLOID YEAST. David Freifelder and Robert B. Uretz (Univ. of Chicago). *Nature* **187**, 953-4 (1960) Sept. 10.

Experimental cells of diploid yeast were suspended in a phosphate buffer at pH 7. This suspension was exposed first to x rays sufficient to inactivate a predetermined fraction of the population. Purified acridine orange was then added. After 20 min the cells were irradiated with visible light. In all cases, this subsequent irradiation with low doses of visible light increased the surviving fraction, indicating a repair or by-pass of part of the damage produced by the x rays. With increasing dose, simultaneous killing by the visible light first lessened and finally overcame the observed reactivations. This reactivation was not found in haploid yeast. (M.C.G.)

25337

EFFECT OF GLYCERINE ON THE X-RAY SENSITIVITY OF *SERRATIA MARCESCENS*. D. L. Dewey (Mount Vernon Hospital, Northwood, Middx., Eng.). *Nature* **187**, 1008-10 (1960) Sept. 17.

Radiation protection by glycerine was examined using the small red-pigmented bacterium *Serratia marcescens*. Observations indicated that the protection of aerobic organisms was brought about by some mechanism other than oxygen scavenging or competition with oxygen for radiolinduced radicals. Organisms that were anaerobic when irradiated were also substantially protected by the presence of glycerine. Overnight cultures grown in unaerated nutrient were diluted in phosphate buffer and suspended in glycerine solution a few minutes before irradiation. The protective effect of glycerine was found to be independent of a change in oxygen concentration by a factor of 100 and also independent of temperature changes. The ratio of sensitivity of the bacteria in the absence of glycerine to its sensitivity in glycerine was found to be 5.25. (M.C.G.)

25338

LABILIZATION OF DEOXYRIBONUCLEIC ACID IN THYMUS NUCLEOPROTEIN AFTER WHOLE-BODY IRRADIATION. Ulrich Hagen (Heiligenberg-Institut, Baden, Ger.). *Nature* **187**, 1123-4 (1960) Sept. 24.

Rats were irradiated with 200 kev x rays in order to study the firmness of the binding between the deoxyribonucleic acid and its protein. A maximum yield of deoxyribonucleic acid was obtained from the thymus with 2% trichloroacetic acid. The yields were much greater after whole-body irradiation than that from a normal thymus. The increase in yield was dependent on the dose. The observed effect can be explained either by a break or weakening of some bivalent metal linkage between deoxyribonucleic acid and protein or by a higher concentration of deoxypolynucleotides in the thymus. (M.C.G.)

25339

SYNTHESIS OF DIPHOSPHOPYRIDINE NUCLEOTIDE IN IRRADIATED RATS. D. K. Myers (Atomic Energy of Canada, Ltd., Chalk River, Ont.). *Nature* **187**, 1124-5 (1960) Sept. 24.

Synthesis of diphosphopyridine nucleotide *in vivo* follow-

ing injection of nicotinamide was not abolished when rats were exposed to x radiation in doses up to 1,500 r at 3 to 60 min before the injection. Since the synthesis of this nucleotide is restricted to the nucleus of the cell and requires adenosine triphosphate, this suggests that appreciable amounts of adenosine triphosphate are still available to the cell nuclei during the first 2 or 3 hr after irradiation. (M.C.G.)

25340

MEDICAL STATUS OF MARSHALLESE IN 1959, FIVE YEARS AFTER EXPOSURE TO FALLOUT RADIATION. R. A. Conard (Brookhaven National Lab., Upton, N. Y.), L. M. Meyer, W. W. Sutow, B. S. Blumberg, A. Lowery, S. H. Cohn, W. H. Lewis, Jr., J. W. Hollingsworth, and H. W. Lyon. *Nuclear-Med.* **1**, 314-30 (1960). (In English)

A medical survey of the Marshallese people in March 1959, five years after exposure to fallout radiation, showed that the people had recovered from the acute effects of their radiation exposure and appeared to be generally in good health. No illnesses or diseases were found that could be directly associated with acute radiation effects. One case of cancer and three deaths had occurred, but with no direct relation to radiation effects. Fertility did not appear to be affected. The incidence of miscarriages and stillbirths appeared to be somewhat higher than in the unexposed Marshallese, but a deficiency of vital statistics precluded definite conclusions as to whether or not this is a radiation effect. Suggestive evidence of slight lag in growth and development of exposed children noted previously was re-evaluated on the basis of better age data obtained during the latest survey. Blood platelet levels were within the normal range but somewhat below that for the unexposed population. Only 12 cases showed residual changes in the skin from β burns. None showed any evidence of cancerous change. Possible late effects of radiation such as shortening of life span, premature aging, increased incidence of leukemia and malignancies, increased incidence of degenerative diseases, opacities of the lens of the eyes, and genetic changes were not detected. The original body burdens of internally absorbed fission products appeared to be too low to have produced any acute or long-term effects. The return of the people to the slightly contaminated island of Rongelap resulted in some increase in body burdens of Cs^{137} , Zn^{65} , and Sr^{90} . However, the levels were far below the accepted maximum permissible limits, and it is not believed any detrimental effects will result. (auth)

25341

EFFECTS OF IRRADIATION *IN VITRO* ON CALCIFYING MECHANISM OF EPIPHYSEAL CARTILAGE. Albert Hirschman and Stanley H. Shapiro (State Univ. of New York, Brooklyn). *Proc. Soc. Exptl. Biol. Med.* **104**, 659-62 (1960) Aug.-Sept.

X irradiation of rachitic epiphyseal cartilage with 250,000 r resulted in small decrease in calcifiability, loss of β -metachromatic granules from some cells of the proliferative zone, and a slight general decrease in staining of the hypertrophic zone. X irradiation with 500,000 r resulted in marked decrease in calcifiability, loss of most of the β -metachromatic granules from the proliferative zone, and loss of γ -metachromatic granules from some cells of the hypertrophic zone. X irradiation with 1,000,000 r resulted in almost complete loss of both calcifiability and stainability with toluidine blue. Toluidine-blue staining of fresh sections of epiphyseal cartilage was employed for demonstration of metachromatic substances. Once the process of calcification had been initiated, the inactivating

effect of irradiation on calcifiability was considerably reduced. A change in mucopolysaccharide resulting in increase of free electronegative groups is a factor associated with calcifiability of epiphyseal cartilage. (auth)

25342

ERYTHROCYTE REPOPULATION IN X-IRRADIATED RECIPIENTS OF NUCLEATED, PERIPHERAL BLOOD CELLS OF NORMAL MICE. Raymond A. Popp (Oak Ridge National Lab., Tenn.). Proc. Soc. Exptl. Biol. Med. **104**, 722-4(1960) Aug.-Sept.

Strains of mice are being produced that are isogenic with inbred stocks except for the hemoglobin locus. With mice of such strains, experiments were carried out to ascertain whether peripheral blood of normal mice contains cells capable of repopulating the marrow of irradiated recipients. In 3 of 5 recipients injected intravenously with ~100 million nucleated peripheral blood cells after 600 r, increasing numbers of graft-derived erythrocytes were noted within 60 days after treatment, indicating the presence in peripheral blood of cells that are able to give rise to mature erythrocytes. (auth)

25343

INFLUENCE OF AGE AT TIME OF IRRADIATION ON INDUCTION OF LEUKEMIA AND OVARIAN TUMORS IN RF MICE. A. C. Upton, T. T. Odell, Jr., and E. P. Sniffen (Oak Ridge National Lab., Tenn.). Proc. Soc. Exptl. Biol. Med. **104**, 769-72(1960) Aug.-Sept.

RF mice exposed to 100 to 300 r of whole-body x rays at various ages from before birth to 180 days after birth showed age-dependent variations in susceptibility to leukemia induction. Susceptibility to induction of granulocytic leukemia was minimal when irradiation was carried out during gestation or shortly after birth, rising later to a maximum at about 70 days of age. Susceptibility to induction of thymic lymphomas was, likewise, apparently minimal during gestation but maximal shortly after birth, declining later in life at the time of thymic involution. Susceptibility to induction of ovarian tumors was relatively low in mice irradiated in utero. (auth)

25344

REDUCTION OF RADIATION SENSITIVITY OF DRY BACTERIAL SPORES WITH HYDROGEN SULFIDE. E. L. Powers and B. F. Kaleta (Argonne National Lab., Ill.). Science **132**, 959-60(1960) Oct. 7.

Hydrogen sulfide reduced the lethal effect of x rays in dry spores by ~50% when given after irradiation and by ~75% when present during irradiation. The first effect was the result of removal of radicals that are toxic when combined with oxygen; the second was the removal of radicals that become toxic in the absence of oxygen. With these results an explanation of the action of sulfhydryl compounds in protection against radiation damage was constructed. (auth)

25345

THE EFFECTS OF X RADIATION ON THE ENDOGENOUS RESPIRATION OF DIFFERENT ORGANS. Heinz Breuer and Heinz Karl Parchwitz (Universitätsklinik und -Poliklinik, Bonn). Strahlentherapie **113**, 83-8(1960) Sept. (In German)

The effect of x radiation (3×10^5 r, 6×10^5 r, and 12×10^5 r) on the respiration of slices of kidney cortex, liver, and spleen of male guinea pigs was examined in the presence of glucose or α -oxoglutarate. The oxygen uptake of the kidney cortex slices increased independent of the substrate. On the other hand, the respiration of liver slices was inhibited when glucose was used; whereas, in the presence of α -oxoglutarate only 12×10^5 r had an in-

hibitory effect. The respiration of spleen slices was reduced considerably in all cases independent of the substrate added. The possible mechanism of the radiation-induced changes of the respiration is discussed briefly. (auth)

25346

STUDIES IN BIOLOGICAL RADIATION PROTECTION. REPORT XXXIV. FURTHER STUDIES ON THE RADIO-PROTECTIVE EFFECTS OF VITAMIN B₆ DERIVATIVES WITH -SH GROUPS. Ruprecht Koch and Ullrich Schmidt (Universität, Freiburg i. B.). Strahlentherapie **113**, 89-99(1960) Sept. (In German)

Trials with 5-mercaptopyridoxine after oral application show that this sulfhydryl substance, even given up to 2 hr before radiation injury, possesses a protective effect. Whole-body irradiated mice were further examined using 5-mercaptopyridoxine disulfide, 4,5-dimercaptopyridoxine, and 4-mercaptopyridoxine. These substances have no radiation-protective effect. On the other hand, this effect is shown by 4-desoxy-5-mercaptopyridoxine and 5-mercaptopyridoxine-thioacetate. It is assumed that the position of the sulfhydryl group in the pyridoxine ring in position 5 as a specific for the radiation-protective effect in animals and the importance of such an assumption for the acting mechanism is indicated. (auth)

25347

EFFECTS OF RADIUM EMANATION IN THE THERMAL GALLERY OF BADGASTEIN/BÖCKSTEIN ON THE SCHULTZ-DALE ANAPHYLACTIC REACTION. Erich Semenzitz (Forschungsinstitut Gasteln der Österreichischen Akademie der Wissenschaften, Gasteln, Austria). Strahlentherapie **113**, 128-35(1960) Sept. (In German)

Guinea pigs, sensitized against horse serum, were put into the thermal gallery of Badgastein/Böckstein. The emanation contents of the air were 2.5 to 3.0 nano curies per liter. The stay in the gallery had a significant desensitization effect in more than two-thirds of the animals. In 14 out of 20 animals an atypical or no contraction of the uterus was observed in the anaphylactic experiment of Schultz-Dale. The passive anaphylactic experiment was also negative in the atypical reacting animals. (auth)

25348

RENAL TRANSPLANTATION IN AZOTEMIC DOGS. John A. Mannick, John H. Powers, James Mithoefer, and Joseph W. Ferrebee (Mary Imogene Bassett Hospital, Cooperstown, N. Y.). Surgery **47**, 340-5(1960) Feb.

A method for producing chronic azotemia or uremia in dogs is described. One kidney is removed and the other damaged by perfusion with the 6-aminonucleoside of Puromycin. Dogs with chronic azotemia were found to tolerate homografts of kidney for longer periods than do normal dogs (15 to 21 days in 4 azotemic dogs as compared with a rejection time of 7 days in 4 normal dogs). Three azotemic dogs were subjected to total body irradiation for the purpose of reducing immune responses. The radiation tolerance of these dogs did not seem different from that of normal dogs. In one of these animals, after 1,300 r of whole body exposure, a kidney homograft inserted on the second day after irradiation functioned normally until death of the animal from marrow aplasia on day 15. From these preliminary observations it is concluded that the potentiation of kidney homograft survival that is known to follow nitrogen retention and whole body irradiation may be studied satisfactorily on an experimental basis in the dog. (auth)

25349

EFFECTS OF EXTERNAL IRRADIATION ON DOMESTIC ANIMALS. Daniel G. Brown (UT-AEC Agricultural Re-

search Lab., Oak Ridge, Tenn.). Texas Eng. Expt. Sta. Misc. Publ. E 72-60 67-70(1960) Apr.

The LD_{50/30} for cattle, sheep, swine, and burros exposed to external whole-body γ irradiation varies from 525 to 780 r. From the standpoint of acute mortality in burros, neutron radiation appears to be more effective than γ radiation and lower energy γ rays of Ta¹⁸² and Zr-Nb⁹⁶ are more effective than the higher energy γ rays of Co⁶⁰. The dose rate appears to be an important factor in the effectiveness of γ irradiation. The clinical response varies somewhat with the species. The most consistent change observed in all species studied is a reduction in cellular elements of the blood. The physical symptoms commonly observed, except for central nervous system disturbance in the burros, are diarrhea, nasal discharge, lacrimation, anorexia, posterior weakness, and dyspnea. The most frequent gross lesion observed at necropsy is hemorrhage, which is represented clinically by a hemorrhagic syndrome. We have not observed any symptoms or lesions that might be considered pathognomonic for irradiation damage. Animals that recover from acute irradiation effects appear to function as normal animals for a period of time. This period of time varies from a few months to several years. The death rate in burros surviving prompt neutron- γ irradiation from an atomic detonation is much higher than in burros surviving γ irradiation from isotopic sources. The majority of deaths in each of the above-mentioned groups are associated with a decrease in platelets and leucocytes. The mechanisms responsible for delayed effects are obscure and are not revealed by the clinical tests performed. (auth)

25350

CLINICO-ROENTGENOLOGICAL STUDY OF THE EFFECT OF IONIZING RADIATION ON THE CONDITION OF THE CARDIOVASCULAR SYSTEM. V. V. Zodieva, I. M. Yakhnich, V. F. Belyaeva, and T. A. Teslya (State Inst. of Roentgen-Radiological Research, Ministry of Health, USSR). Vestnik Rentgenol. i Radiol. 35, No. 3, 24-9(1960) May-June. (In Russian)

A study was conducted of morphological and functional changes occurring in the cardiovascular system of patients suffering from cancer of the esophagus and lungs and subjected to radiation therapy. The clinical investigation and observation of the patients was carried out with the aid of electrocardiography, phonocardiography, roentgenoscopy, orthodiagraphy, and roentgenkymography. Sixty patients were examined prior to, during, and 6 or more months after treatment. The patients were irradiated by a total dose of 5,000 to 7,500 r. It was concluded that under the effect of ionizing radiation (the dose being 3,000 r and more) there occurs depression of the cardiac activity with reduced contractile myocardial function. In the majority of the irradiated patients arterial pressure diminishes. Electrocardiograms demonstrated decreased voltage of the waves and reduction of the coronary circulation. There was a diminution of the stroke volume and an increase in the minute volume as shown on roentgenokymograms (at the expense of the accelerated rhythm). After a lapse of 6 months following termination of the treatment the blood volume approaches its initial values. The changes observed in the irradiated patients are regarded as manifestations of the functional disturbances. (auth)

25351

ROENTGENOLOGICAL PICTURE OF CHANGES OCCURRING IN THE LUNGS FOLLOWING TELEGAMMA-THERAPY OF CANCER OF THE ESOPHAGUS. A. A. Shluss and Sh. M. Belbutov. Vestnik Rentgenol. i Radiol. 35, No. 3, 30-4(1960) May-June. (In Russian)

An investigation was made of 150 patients subjected to telegammatherapy in connection with cancer of the esophagus. Irradiation of the lateral surfaces of the chest would frequently lead to the development of radiation pneumonia with subsequent massive fibrosis. X-ray examination demonstrated the presence of an intensive shadow, the form and the size of which corresponded to that of the irradiated field. The development of radiation fibrosis was less pronounced in combined irradiation of parasternal and two paravertebral fields. The smallest x-ray and clinical changes were observed in patients in whom only paravertebral and vertebral fields were irradiated. The last method of treatment made it possible to reach the necessary sum total radiation dose without significant injury of the lung tissue. (auth)

25352

THE ORIGIN AND THE COURSE OF ULCERATIONS OF THE SKIN EXPOSED TO RADIATION INJURY. Yaromir Kolarzh and Radko Vrabets. Vestnik Rentgenol. i Radiol. 35, No. 3, 50-4(1960) May-June. (In Russian)

Results are presented for 300 cases with operated and histologically examined ulcers caused by x rays. The difference in the clinical and histological characteristics of individual radiation injuries is emphasized. Malignant changes of the chronic x-ray dermatitis were observed in 22% of the cases and they were seen especially frequently in occupational radiation injuries. In these patients squamous cell carcinoma prevailed while other types thereof were rare. Two hundred and ninety-eight patients were cured following plastic operations, and 2 died at the age of 66 as a result of metastases of radiation carcinoma. (auth)

25353

RADIATION INJURIES RESULTING FROM ERRONEOUS EMPLOYMENT OF X-RAYS FOR DIAGNOSTIC PURPOSES. E. I. Vasil'eva (Central Research Inst. of Medical Radiology, Ministry of Health, USSR). Vestnik Rentgenol. i Radiol. 35, No. 3, 59-60(1960) May-June.

Four cases of acute x-radiation injury induced by diagnostic exposure of hands were studied. The symptoms of local injuries and side effects are discussed and the importance of personnel protection is stressed. (R.V.J.)

Radiation Sickness

25354 TID-6477

Chicago. Univ.

INVESTIGATION OF THE PATHOGENESIS OF RADIATION NEPHRITIS, CLINICAL AND EXPERIMENTAL. Period covered: July 1, 1959 to July 1, 1960 (Complete Report). Benjamin H. Spargo and Seymour Glagov. July 5, 1960. 20p. Contract AT(11-1)-682. OTS.

Enzyme histochemical methods were applied to the study of the x-irradiated rat kidney at severe dose levels and up to 227 days after irradiation. The earliest change noted was a modification in the manner of formazan precipitation in tubule cells. In addition to the fine uniform precipitate seen in the kidneys of control animals, the kidneys of irradiated animals showed accumulations of coarse formazan particles. These coarse granules appeared in tubule cells which seemed intact by standard staining methods and persisted in both apparently intact and atrophic tubules months after irradiation. There was a fairly well-defined comparative distribution of the coarse precipitation in the nephron. Only animals receiving 1000 r or more showed the coarse precipitate. In general, the changes in the hydrogen transfer and phosphatase systems paralleled the paren-

chymal loss and progressive renal fibrosis which characterized the postirradiation period. (auth)

25355 TID-6531

Chile. Universidad, Santiago.

AN IMMUNOGENETIC STUDY OF THE MECHANISMS OF PROTECTION AGAINST RADIATION DEATH BY TREATMENT WITH HAEMOPOIETIC TISSUES. Annual Progress Report from December 1, 1959 to August 31, 1960. Renewal Proposal: December 1, 1960 to November 30, 1961. Gustavo Hoecker. Aug. 31, 1960. 18p. Contract AT(30-1)-2488. OTS.

A study was made of the effect of different combinations of co-isogenic strains of mice differing at several known histocompatible loci on the delayed death of lethally irradiated hosts protected with adult homologous hemopoietic tissue. Combinations differing at H-2 and H-3 were tested, with the result that combinations of irradiated hosts and adult hemopoietic tissue donors differing at H-3 have less probability of developing this syndrome than combinations differing at H-2. Other findings are briefly reported. (T.R.H.)

25356 JPRS-2546(p.27-37)

LESIONS OF THE MYOCARDIUM IN RADIATION SICKNESS AND LOCAL X-IRRADIATION OF THE HEART REGION (EXPERIMENTAL STUDY). S. I. Teplov, V. S. Sverdlov, and B. F. Korovkin (Korobkin). Translated from Med. Radiol. 4, No. 3, 27-33(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 14196.

25357 JPRS-2546(p.38-46)

PECULIARITIES OF THE COURSE OF FROSTBITE IN RADIATION SICKNESS. O. V. Rudenko. Translated from Med. Radiol. 4, No. 3, 34-9(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 14197.

25358 JPRS-2707(p.30-5)

TREATMENT OF RADIATION SICKNESS COMPLICATED BY TRAUMATIC SHOCK. I. V. Il'yinskaya and T. M. Astakhova. Translated from Med. Radiol. 4, No. 10, 38-41(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 4264.

25359 JPRS-2707(p.44-55)

CHANGE IN SENSITIVITY TO VISCERAL TRAUMA OF ANIMALS WHICH HAVE SUFFERED FROM RADIATION SICKNESS. G. Sh. Vasadze and S. G. Sherashov. Translated from Med. Radiol. 4, No. 10, 59-66(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 4267.

25360 JPRS-2707(p.62-8)

METHEMOGLOBIN-FORMATION IN RADIATION SICKNESS. K. S. Kosyakov. Translated from Med. Radiol. 4, No. 10, 71-4(1959).

Results of investigations of methemoglobin formation in dogs that were exposed to total-body x radiation are presented. It was found that methemoglobinemia was not found in dogs exposed to 500 r x radiation any more often during radiation sickness than it was found in healthy control animals. This condition was found in about one-half of the surviving cases and is attributed to the reaction of hemoglobin with endogenous methemoglobin-formers. (J.R.D.)

25361 JPRS-2707(p.69-77)

THE PROPERDINE SYSTEM IN RADIATION SICKNESS.

(Review of the Literature). I. L. Chertkov. Translated from Med. Radiol. 4, No. 10, 75-8(1959).

A literature review of information concerning the effects of radiation on the properdine system in animals is presented. Data and experimental results are discussed, and it is noted that the significance of this system in acute radiation sickness has not been established. Further investigation of the system is indicated as a step in clarification of the problems associated with the pathogenesis and therapy of acute radiation injuries. (J.R.D.)

25362 JPRS-2707(p.83-7)

THE ROLE OF INFECTION AND CHANGE IN THE IMMUNOLOGICAL REACTIVITY IN THE DEVELOPMENT OF THE HEMORRHAGIC SYNDROME OF THE IRRADIATED ORGANISM. N. N. Klemparskaya and V. F. Sosova. Translated from Med. Radiol. 4, No. 10, 82-4(1959).

A discussion of the allergic phenomena associated with radiation sickness is presented. It is proposed that the factors which play an important part in the pathogenesis of the hemorrhagic syndrome in radiation sickness are sensitization of the body by tissue-decomposition products which occur as a result of irradiation and local accumulation of tissue-decomposition products resulting from the action of infectious agents and/or metabolism impairment in progressing radiation sickness. Experimental observations and data are presented for confirmation. (J.R.D.)

25363 JPRS-2743(p.21-8)

CHANGES IN THE HIGHER NERVOUS ACTIVITY IN EXPERIMENTAL CHRONIC RADIATION SICKNESS PRODUCED THROUGH THE EFFECT OF IONIZING RADIATION. Kh. Kh. Yarullin. Translated from Med. Radiol. 4, No. 12, 16-21(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 6182.

25364 JPRS-2743(p.36-52)

CHANGE IN THE MUCOPOLYSACCHARIDES AND THE HYALURONIDASE INHIBITOR IN THE BLOOD AND TISSUES OF ANIMALS IN ACUTE RADIATION SICKNESS. Z. I. Sheramet, V. M. Manteyfel, and M. O. Raushenbakh. Translated from Med. Radiol. 4, No. 12, 25-35(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 6183.

25365 JPRS-2743(p.126-7)

REGULAR CHANGES IN THE LEUCOCYTIC REACTION IN RESPONSE TO THE INJECTIONS OF SODIUM NUCLEINATE IN RADIATION SICKNESS IN ANIMALS. P. V. Simonov. Translated from Med. Radiol. 4, No. 12, 80(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 6151.

25366 JPRS-5016(p.1-10)

CHANGE IN THE LIVER FUNCTION FROM THE PROLONGED EFFECT OF IONIZING RADIATION. V. A. Ankudinov and E. (Ye.) D. Semiglazova. Translated from Med. Radiol. 5, No. 4, 3-6(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 15561.

25367 JPRS-5016(p.70-83)

CHANGES IN THE NEURAL APPARATUS OF THE LUNGS IN ACUTE RADIATION SICKNESS. V. B. Zairat'yants (Zayrat'yants). Translated from Med. Radiol. 5, No. 4, 29-34(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 15563.

25368 JPRS-5016(p.84-91)

PROTECTION AGAINST EARLY RADIATION INJURIES TO THE BONE MARROW. I. K. Krasnykh, N. P. Lebkova, and S. P. Yarmonenko. Translated from Med. Radiol. 5, No. 4, 35-7(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 15546.

25369 JPRS-5016(p.104-14)

PATHOLOGY OF THE ACUTE AND SUBACUTE PHASES OF RADIATION SICKNESS IN ANIMALS AFTER THE IRRADIATION OF THEM WITH URANIUM FISSION PRODUCTS. A. A. Pinus and A. P. Novikova. Translated from Med. Radiol. 5, No. 4, 43-6(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 15564.

25370 JPRS-5016(p.222-3)

VITAMIN C IN THE LIVER AND SMALL INTESTINAL WALL IN RADIATION SICKNESS IN ANIMALS WHICH SYNTHESIZE ASCORBIC ACID. N. E. (Ye.) Glushakova, F. M. Laguto, and O. S. Luchenok. Translated from Med. Radiol. 5, No. 4, 86(1960).

In radiation sickness of rats (animals that synthesize ascorbic acid) a prolonged disturbance in the ascorbic acid metabolism was observed. During the first few days after irradiation, the ascorbic acid content increased in the liver and decreased in the small intestine. Later a reduction was also observed in the liver. After the 21st day, the content of iron-bound ascorbic acid in the tissues increased. Immediately after irradiation, there was a notable reduction in the capacity of the hepatic tissue of reducing dehydroascorbic acid. (M.C.G.)

25371 JPRS-5078(p.60-70)

THE INFLUENCE OF REPEATED INJECTIONS OF DISTILLED WATER ON THE COURSE OF ACUTE RADIATION SICKNESS IN DOGS. N. N. Klemparskaya and N. V. Raeva (Rayeva). Translated from Med. Radiol. 5, No. 2, 26-30(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 12479.

25372 JPRS-5078(p.77-84)

THE EFFECT OF CERTAIN PREPARATIONS FROM THE ARALIA FAMILY OF PLANTS IN EXPERIMENTAL RADIATION SICKNESS. I. I. Brekhaman, L. I. Oskotskii (Oskotskiy), and A. I. Khakham. Translated from Med. Radiol. 5, No. 2, 33-6(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 12508.

25373 JPRS-5099

CHEMICAL AGENTS FOR THE PROPHYLAXIS OF ACUTE RADIATION SICKNESS. F. Yu. Rachinskiy (Rachinskiy), A. S. Mozhukhin, N. M. Slavachevskaya, and L. I. Tank. Translated from Uspekhi Khim. 28, 1488-1522(1959). 75p. OTS.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 13645.

25374 JPRS-5124(p.187-92)

BLOOD CHANGES IN THE ULTRA-VIOLET SPECTRUM IN

RADIATION SICKNESS. K. S. Kosyakov. Translated from Med. Radiol. 5, No. 3, 74-5(1960).

Experiments are described on the suitability of ultra-violet spectrophotometry for diagnosis of radiation injury according to changes in whole blood. Some changes were detected in the 2800 to 2950 Å region, but the method is not recommended for clinical purposes. (T.R.H.)

25375 JPRS-5403(p.93-101)

THE INFLUENCE OF LIVER AND BONE-MARROW HOMOGENATES ON THE SURVIVAL RATE OF IRRADIATED RATS. S. A. Rogacheva and N. P. Kudasheva. Translated from Med. Radiol. 5, No. 5, 43-6(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 20113.

25376 JPRS-5403(p.102-12)

THE TESTING OF INDOLAMINE COMPOUNDS IN THE PROPHYLAXIS OF RADIATION SICKNESS. L. F. Semenov. Translated from Med. Radiol. 5, No. 5, 47-52(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 20114.

25377 JPRS-5403(p.136-41)

A CLINICAL EVALUATION OF THE DEGREE OF EXPRESSION OF THE HEMORRHAGIC SYNDROME IN DOGS IN ACUTE RADIATION SICKNESS. N. V. Butomo. Translated from Med. Radiol. 5, No. 5, 63-6(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 20115.

25378 JPRS-5403(p.142-69)

THE PROBLEM OF THE THERAPEUTIC APPLICATION OF BONE MARROW IN RADIATION SICKNESS. M. O. Raushenbakh and M. P. Khokhlova. Translated from Med. Radiol. 5, No. 5, 67-74(1960).

A review is made of the use of hematopoietic tissues, particularly bone marrow, in radiation injuries. The most definite results were obtained in experiments on mice. In contrast to control mice that died during the 21 days after irradiation, the intravenous injection of homologous bone marrow was responsible for the survival of 68 to 100% of the mice. Similar results were obtained in experiments on rats. The injection of bone marrow of healthy rats into rats irradiated with lethal doses increased the survival rate to 30%, stimulated hematopoiesis, and increased the natural resistance of rats to infection with typhoid bacteria. In rabbits, the survival rate was increased to 60%. In tests on monkeys, injections of bone marrow increased the length of survival after irradiation. Protective effects were also noted in experiments on dogs. Bone marrow injections had a good therapeutic effect in four of five Yugoslavian patients treated for radiation sickness. The problem of obtaining bone marrow cells, the methods of injecting them into the recipient, and problems in preserving bone marrow are discussed. The protective effects of bone marrow after injections of myleran and radioactive gold and after artificially produced radiation aplasias of hematopoiesis in patients with leukemia were studied. The possibility of serious complications developing in the form of so-called "homologous" or "secondary" diseases is also discussed. Two theories of the therapeutic effect were studied: the hypothesis of humoral stimulation and the hypothesis of cell transplantation. (M.C.G.)

25379 JPRS-5454

THE FUNCTIONAL MORPHOLOGY OF THE HEART IN RADIATION SICKNESS. (Funksional'naya Morfologiya

Serdtsa pri Luchevoy Bolezni). S. N. Sergeev (Sergeyev). Translated from *Ark. Patol.* 22, No. 4 (1960). 8p. OTS.

Experiments were performed on 77 rabbits to study the effects of increased physical stress on the development of heart failure due to radiation. A single 1000-r dose was administered with a RUM-3 apparatus, and then the animals were debilitated by racing. Daily physical stress evoked an abrupt onset of marked morphologic-myocardiac affection in the form of protein and fatty dystrophy; 11 out of 21 died. When the rabbits are exerted two or three weeks prior to irradiation, the dystrophic-myocardiac changes were lessened or prevented. Daily pre-irradiation physical stress favored prevention of dystrophic-myocardiac changes. (T.R.H.)

25380

THE CHANGES OF CONDITIONED DEFENSIVE REFLEXES IN DOGS IN RADIATION SICKNESS. P. I.

Lomonos (Inst. of Experimental Medicine, USSR).

Ezhegodnik Inst. Eksptl'. Med. Akad. Med. Nauk S.S.S.R. 2, (M), 579-87 (1957). (Translated from *Referat. Zhur. Biol.* No. 4, 1959, abstract No. 18077).

Two dogs received general roentgen irradiation in a dose of 400 r with a power of 17 r/min. To a third dog a solution of P^{32} in a dose which corresponded to about 200 r was introduced intravenously. In all dogs, defensive-conditioned reflexes (CR; raising of paw) were produced. The latent period, the number of raisings of the paw in response to the conditioned stimulus, the number of respiratory movements during its duration, and the number of intersignal reactions were registered. The clinical picture of the disease was determined according to morphological composition of blood and weight of the animals. In both variations of irradiation, phase changes of the values of CR were observed. The periods of relative decrease of the values of CR coincided with the critical periods of the course of radiation sickness. The periods of fall of the number of leucocytes in the blood either preceded the periods of relative decrease of values of CR, or coincided with them. Normal interrelations between the values of CR in their decrease were preserved, which apparently indicates an increase of processes of inhibition at the expense of induction influences from other regions of the nervous system.

25381

EFFECTS OF IONIZING RADIATION ON IMMUNITY REACTIONS WITH REPEATED TRANSFUSIONS OF BONE MARROW IN RABBITS. B. Bellion, C. Ricci, S. Chiarle, E. Peracino, and L. Resegotti (Università, Turin). *Minerva nucleare* 4, 194-8 (1960) July-Aug. (In Italian)

The blood picture and immunologic pattern were studied in normal rabbits given repeated transfusions of bone marrow with or without previous irradiation with sublethal doses. The repeated intravenous administration of isologous bone marrow determined a marked drop in the blood values in all the non-irradiated animals in coincidence with the appearance of complete and incomplete warm isoantibodies with titers up to 1/125. In animals given total irradiation with 400 r the transfusions of bone marrow determined a prompter normalization of the blood values, whereas the appearance of anti-bone marrow isoantibodies was never noted. The practical value of these observations was briefly considered. (auth)

25382

CLINICAL EFFECTS OF RADIATION: ACUTE RADIATION SYNDROME AND CIVIL DEFENSE. Herbert B. Gerstner (School of Aviation Medicine, Brooks Air Force Base, Texas). *Texas Eng. Expt. Sta. Misc. Publ. E 72-60* 47-56 (1960) Apr.

Throughout the several-hundred-roentgen range, human whole-body exposure to penetrating ionizing radiation provokes a train of clinical events in which a succession of several discrete phases can be clearly distinguished. These events are exposure, delay period, prodromal reaction, latent period, phase of overt bone-marrow depression, and period of convalescing. Each of these phases is analyzed and discussed from two points of view: first, the peculiar duration, characteristic clinical manifestations, and special therapeutic requirements are derived from past experience (radiotherapy patients, Japanese bomb casualties, and persons involved in reactor accidents); second, after projection of the clinical sequence against the background of a hypothetical future disaster, the implication of each of the phases is evaluated for large-scale nuclear accidents and civil defense emergencies. (auth)

CHEMISTRY

General and Miscellaneous

25383 AERE-R-3309

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

MEASUREMENT OF THE VISCOSITY OF SANTOWAX 'R', PARA-, META- AND ORTHO-TERPHENYL, DIPHENYL AND DOWTHERM 'A'. R. W. Bowring, G. L. Christie, and D. A. Garton. July 1960. 52p. BIS.

The viscosities of Santowax R, P-, M-, and O-terphenyl, and Dowtherm A were measured from near the melting point to near the boiling point of each liquid with a falling-cylinder (Lawoczek type) viscometer. (C.T.G.)

25384 NP-9179

Hooker Chemical Corp., Niagara Falls, N. Y. RESEARCH AND DEVELOPMENT OF HIGH TEMPERATURE STABLE ORGANO-PHOSPHORUS COMPOUNDS. Quarterly Progress Report No. 1 [for] May 1, 1960 to August 1, 1960. Charles F. Baranaukas, Edward E. Harris, and Robert J. Lisanke. Aug. 15, 1960. 104p. Contract AF33(616)-7191.

Activities in a program to synthesize suitable organo-phosphorus compounds that are stable at high temperatures and to develop evaluation procedures are summarized. The report period was devoted to preparation of tertiary aryl phosphines and phosphine oxides for evaluation as high-temperature fluids and lubricants. Several intermediate compounds for use in synthesis and for future use were also prepared. Results of a literature survey on tertiary phosphines and tertiary phosphine oxides development in the period 1950 to 1960 are included. (J.R.D.)

25385 NP-9194

Stanford Research Inst., Menlo Park, Calif. ORGANIC FIBER FILTERS. PART I. A METHOD OF PRODUCING ORGANIC FIBER FILTERS FOR AEROSOL SAMPLING. PART II. A SURVEY OF SOURCES OF ORGANIC FILTER MATERIAL APPLICABLE TO ATMOSPHERIC SAMPLING. Final Report. William C. Thuman. Dec. 1, 1959. 74p. Project No. SU-2261. Contract AF19(604)-2644.

Organic fiber filters were developed for aerosol sampling. Organic fibers were produced by dispersing solutions of polystyrene in methylene chloride into a high-velocity air stream. A jet of the solution was broken up and drawn out into fibers from which the solvent evaporated. The dried fibers were collected to form a mat. Fil-

ter efficiency was 98% for solid aerosol particles of 0.01 to 1 μ in diameter at a face velocity of 14 cm/sec at atmospheric pressure. Filters were prepared in the size of 24 by 70 in. Alternate methods of producing the fibers and subsequent filter fabrication were investigated. (C.J.G.)

25386 ORNL-2983(p.32-43)

Oak Ridge National Lab., Tenn.

ORGANIC CHEMISTRY. B. M. Benjamin, C. J. Collins, et al.

The deamination of several diarylaminopropanols and diethylpropylamines was studied with stereochemical and radiochemical techniques. The results are best interpreted in terms of classical carbonium-ion intermediates which undergo rearrangement or nucleophilic attack more rapidly than rotation about the carbon-carbon bond takes place. A secondary isotope effect of $k^*/k = 1.008 \pm 0.001$ was observed in the formation of the 2,4-dinitrophenylhydrazone of (aceto-2-C¹⁴)-phenone. The mode of formation of substituted tetrahydropyrans among the products of the Grignard reactions of certain allylic systems was studied. The ratio of the ionization constant of formic acid to that of formic-d acid (DCOOH) in aqueous solution was measured at $24 \pm 0.5^\circ\text{C}$. The result fails to support a suggestion that the effect of alpha deuterium substitution on the ionization constant of phenylacetic acid is exerted mostly through an inductive mechanism. C¹⁴ was employed in the evaluation of the deuterium kinetic isotope effects in the photochemical reactions of chlorine and bromine with formic-d acid. Through the use of the mass spectrometer a search was made for an intermediate during the photochemical reaction of formic acid with chlorine. Chloroformic acid, which was reported by other workers to be an intermediate, could not be detected. Cationic complexes with dibutylphosphoric acid were prepared in analytical purity. Metathesis of the complexes has been demonstrated with aqueous alkali. The mutual solubility of tributylphosphine oxide and water as a function of temperature and the distribution of tributylphosphine oxide between carbon tetrachloride and water were determined refractometrically. The method that was developed for the use of the refractometer proved more useful than the synthetic method using the cloud point. The initial reaction of tributyl phosphate upon heating is the formation of large yields of butene-1 and dibutylphosphoric acid, with lesser yields of butanol, butyl ether, and tetrabutyl pyrophosphate. The rate of decomposition increases as the amount of acid produced increases. Differential thermal analysis has been used to define the conditions where one obtains endothermic and exothermic reactions between tributyl phosphate and nitric acid or nitrate salts. The results have been used to develop a safe and satisfactory synthesis of butyl nitrate by the dealkylation of tributyl phosphate. Sulfuric acid (95%) and Amsco 125-82 react at 25°C to produce low-boiling hydrocarbons. This reaction removes compounds that would otherwise react in the solvent extraction process to reduce the separation factors. (auth)

25387 TID-6414

Case Inst. of Tech., Cleveland.

COPRECIPITATION FROM HOMOGENEOUS SOLUTION. Annual Progress Report. Louis Gordon, Kazuyoshi Takiyama, Jacob Block, Norton Haberman, Thomas H. Richert, and Eugene D. Salesin. June 1, 1960. 100p. Contract AT(11-1)-582. (CITC-582-1). OTS.

With this is bound: Socony Mobil Oil Co., Inc., Paulsboro, N. J. and Case Inst. of Tech., Cleveland. THE MINIMUM IGNITION TEMPERATURE OF ALUMINUM OXIDE PRECIPITATES. Oscar I. Milner and Louis Gordon.

Activities in the general research areas of coprecipitation of trace substances on host crystals, elucidation of nucleation phenomena, development of reactions for precipitating metal chelates from homogeneous solution, and development of applicable analytical methods are reported. A coprecipitation study using Se⁴⁶ as tracer and uranous oxalate as carrier is almost complete; preliminary data are included. Other research is reported on the nucleation of lead chromate, methods for precipitation of niobium and tantalum from homogeneous solution, and generation of dimethylglyoxime and 8-hydroxyquinoline. The reaction for generating 8-hydroxyquinoline is being used to study the precipitation of thorium and in nucleation studies. Papers dealing with AgCl nucleation, general precipitation processes, the ignition temperature of Al₂O₃, and preparation of 8-acetoxyquinoline are included. (J.R.D.)

25388 TID-6510

Michigan. Univ., Ann Arbor. Coll. of Literature, Science, and the Arts.

DEUTERIUM ISOTOPE EFFECTS IN THE GAS PHASE OXIDATION OF FORMALDEHYDE BY NITROGEN DIOXIDE. Donald Barton. Aug. 1960. 19p. Contract AT(11-1)-321. OTS.

Deuterium isotope effects in the kinetics of the gas-phase oxidation of formaldehyde by nitrogen dioxide are reported at 126°C . The competitive isotope effect for 1% CD₂O in CH₂O is ~ 3.0 . No exchange reaction forming CHDO is detectable under the conditions of the competitive experiments. By means of separate experiments with CH₂O and CD₂O the ratio of second-order rate constants is found to be 13.5 ± 1.5 . The CO:CO₂ ratio in the products decreases when CD₂O is substituted for CH₂O. The kinetic and stoichiometric observations for 2:1 initial NO₂:CH₂O ratios agree substantially with those in the literature. However, when the ratio NO₂:CH₂O is reduced, the stoichiometric relationships change, favoring CO. A chain mechanism accounting for most of the observations is presented, in which hydrogen abstraction reactions play a major role. (auth)

25389 UCRL-6055

California. Univ., Livermore. Lawrence Radiation Lab. EXPLOSIVES—A BIBLIOGRAPHY. Carl J. Wensrich. July 1960. 21p. Contract W-7405-eng-48. OTS.

The information presented in this bibliography was taken from books, published literature, and reports, and covers the period 1950 to April 1960. (W.L.H.)

25390 UCRL-8879

California. Univ., Berkeley. Lawrence Radiation Lab. CHEMISTRY OF SOME HYDROLYZED Cr(III) POLYMERS. James Edgar Finholt. Apr. 16, 1960. 66p. Contract W-7405-eng-48. OTS.

Two polynuclear Cr(III) species were isolated from refluxed chromic perchlorate and chromic nitrate solutions. The separations were made using an ion-exchange elution. The formulas of the species are believed to be Cr₂(OH)₂⁴⁺ or Cr₂O⁴⁺ and Cr₃(OH)₃⁵⁺ or Cr₃O₃⁵⁺. Two ion-exchange techniques were especially useful in this identification. In one, the charge per chromium atom was determined from material and charge-balance considerations during an elution. In the second, the charge per species was determined from consideration of the equilibrium distribution of the unknown species relative to a known ion between a known amount of resin and a fixed volume of aqueous solution. Evidence of chromic perchlorate complexing within the resin of these species was found. Similar studies indicated perchlorate complexing of Fe(III), Ce(III), Th(IV), and La(III) within the resin. (auth)

25391 UCRL-9285

California. Univ., Berkeley. Lawrence Radiation Lab. HIGH-PRESSURE VAPOR-LIQUID EQUILIBRIUM APPARATUS (thesis). Robert Lawrence Miner. July 1960. 56p. Contract W-7405-eng-48. OTS.

Equipment was designed and built for the measurement of the high-pressure solubility of oxygen and nitrogen in liquid carbon dioxide near its critical temperature. The equipment is designed to operate at pressures up to 15,000 psi and from -40°C to the critical temperature of carbon dioxide, 31.1°C . Equilibrium is attained by circulating both the liquid and vapor streams. Sections of the circulation lines are blocked off to trap the samples. Auxiliary equipment is included for the following purposes: refrigerating and controlling the constant-temperature bath; measuring the equilibrium temperature and pressure; measuring the liquid level in the equilibrium vessel; determining the density of the samples; analyzing the samples; and calibrating the analytical system. (auth)

25392 USNRDL-TR-452

Naval Radiological Defense Lab., San Francisco. LIQUID SCINTILLATION COUNTING OF TRITIATED THYMIDINE INCORPORATED INTO DEOXYRIBONUCLEIC ACID. R. K. Main and E. R. Walwick. July 26, 1960. 15p.

A method of measuring the incorporation of tritiated thymidine into DNA by employing liquid-scintillation-counting techniques was devised. After incorporation of tritiated thymidine into DNA by enzymatic procedures, the resulting tritiated DNA was hydrolyzed with formic acid for 30 min at 175°C , thus releasing tritiated thymine. Evidence is presented to show that tritium is not lost from tritiated thymine during formic acid hydrolysis. Samples were counted in an automatic liquid-scintillation 2-channel spectrometer and corrected for quencher by a tested internal-standard procedure. (auth)

25393 AEC-tr-4138

INTRODUCTION TO CRYSTAL CHEMISTRY. (Vvedenie v Kristallokhimiyu). Books 1 and 2. G. B. Bokii. Translated from a publication of the Moscow University Publishing House, 1954. 537p. OTS.

Basic concepts of crystal chemistry are reviewed. Essential factual material and definition of terms are included. In addition, all of the existing information on the structures of simple substances and binary compounds is tabulated. (J.R.D.)

25394 AEC-tr-4238

Akademiya Nauk S.S.S.R. Institut Atomnoi Energii. STUDY OF AMERICIUM AND CURIUM COMPLEXES WITH α -HYDROXYISOBUTYRIC ACID. V. B. Dedov, M. N. Ryzhov, P. S. Trukhyaev, and G. N. Yakovlev. 1960. Translated by Helen J. Chick and Robert A. Penneman (Los Alamos Scientific Lab.). 12p. JCL or LC.

Separation and behavior of americium and curium complexes with α -hydroxyisobutyrate were studied. Ion exchange was used in the investigation since this method lends itself to the use of tracers. Results and conclusions are included. (J.R.D.)

25395 CEA-tr-R-829

ETUDE DE LA FORMATION DE COMPLEXES DE ZIRCONIUM EN SOLUTION À L'AIDE DE L'ÉCHANGE IONIQUE. (Study of Zirconium Complex Formation in Solution Using Ion Exchange). A. K. Kirakosyan (Kirakosian) and I. V. Tananaev. Translated into French by M. Fedorovsky from Zhur. Neorg. Khim. 4, 852-6(1959). 12p.

A study was made of the complex formation reactions

between $\text{Zr}(\text{SO}_4)_2$ and oxalic acid, citric acid, and sulfuric acid in solution by an ion-exchange method. It was found that the complex forms when the complex ions $\text{Zr}(\text{C}_2\text{O}_4)_4^{4-}$ and $\text{Zr}_2 \text{ citrate}_7^{3-}$ and dizirconyl oxalate are sufficiently stable and the zirconium sulfate ions are relatively less stable. (T.R.H.)

25396 CEA-tr-R-846

ETUDE DE L'ÉCHANGE ISOTOPIQUE DU BROME ENTRE LES BROMURES DES ÉLÉMENTS ET LES DÉRIVÉS ORGANIQUES BROMÉS. (Study of Isotopic Exchange of Elementary Bromine with Organic Bromine Derivatives). A. N. Nesmeyanov (Nesmelanov), V. Ya. (B. I.) Kabanov, Yu. P. Trusov (I. P. Trussov), and M. M. Privalova. Translated into French from Zhur. Fiz. Khim. 30, 566-76 (1956). 24p.

The activation energies were determined for exchange of bromine between NaBr , RbBr , CaBr_2 , BaBr_2 and $\text{C}_4\text{H}_9\text{Br}$ in acetone and between NaBr and $\text{C}_4\text{H}_9\text{Br}$ in acetonitrile. With the CaBr_2 the exchange kinetics fits the iono-molecular reaction and is affected by CaBr_2 dissociation. The presence of H_2O , alkali, or a salt slowed the exchange in some cases. In some cases there was no exchange, probably owing to lack of dissociation. Other findings are reported and discussed. (T.R.H.)

25397 CEA-tr-R-865

ÉCHANGE ISOTOPIQUE DU SOUFRE ET STRUCTURE DES DISULFOXYDES. (Isotopic Exchange of Sulfur and Structure of Disulfoxides). N. I. Grishko (Grisko) and E. N. Gur'yanova (Gurianova). Translated into French from Zhur. Obshchei Khim. 29, 878-84(1959). 18p.

An isotopic-exchange technique was used to study the structure and reaction capacity of acid thiosulfone ethers. The thiosulfone ethers exchange with elementary sulfur only when heated to 170°C . Exchange of RS groups between thiosulfone ethers and organic disulfides was discovered. The structure of the sulfur sulfones is interpreted as being "disulfoxides." An investigation was made of the effects of composition and structure of the radicals on the exchange capacity of thiosulfone ethers with disulfides and mercaptans. Some conclusions as to the antibacterial action of the sulfur sulfones are offered. (tr-auth)

25398 CEA-tr-R-873

DECARBOXYLATION THERMIQUE DU MÉTHYLACÉTYLSALICYLATE MARQUE AU ^{14}C . (Thermal Décarboxylation of Méthylacétyl Salicylate Labeled with C^{14}). V. G. Vasil'ev (Vassiliev), and E. N. (T.) Kharlamova. Translated into French from Zhur. Obshchei Khim. 29, 1973-81(1959). 23p.

Using C^{14} in the acetoxy group, the kinetics and mechanism of thermal decarboxylation of methylacetylsalicylate were studied at 280, 300, and 320°C . The tracer was used to follow CO_2 emission from the carboxyl groups. The CO_2 is emitted autocatalytically with an activation energy of 38 kcal/mole, preceded by a noncatalytic reaction of 44 kcal/mole. (T.R.H.)

25399

THE CHEMISTRY OF THE SOLVATED METAL CHELATES. II. THE URANIUM(VI), THORIUM(IV) AND SCANDIUM(III) 2-METHYL-8-QUINOLINOL METAL CHELATES. James H. Van Tassel and Wesley W. Wendlandt (Texas Technological Coll., Lubbock). J. Am. Chem. Soc. 82, 4821-3(1960) Sept. 20.

The 2-methyl-8-quinolinol chelates of thorium(IV), scandium(III), and uranium(VI) were studied by chemical, thermogravimetric, and calorimetric methods and infrared spectroscopy. The heat of solvation, ΔH_s , for the reaction $\text{M}(\text{C}_{10}\text{H}_8\text{NO})_n(\text{s}) + \text{C}_{10}\text{H}_8\text{NOH}(\text{s}) = \text{M}(\text{C}_{10}\text{H}_8\text{NO})_n \cdot \text{C}_{10}\text{H}_8\text{NOH}(\text{s})$

was determined for the thorium and uranium chelates and found to be 2.5 ± 0.5 and -2.9 ± 0.5 kcal/mole⁻¹, respectively. It was possible to prepare the unsolvated scandium and uranium chelates by vacuum sublimation techniques and the previously unreported solvated thorium chelate. There was little difference between the infrared spectra of the solvated and unsolvated metal chelates. (auth)

25400

DEFORMATION OF THE URANYL ENTITY IN URANYL-MALATE, -TARTRATE, AND -CITRATE TRIDENTATE CHELATES. Isaac Feldman (Univ. of Rochester, N. Y.). *J. Phys. Chem.* **64**, 1032-4(1960) Sept.

In order to determine if the collinearity of the uranyl ion is destroyed in chelation, a semi-quantitative potential energy function for a tridentate chelate relating the mutual repulsion energies of the uranyl oxygen atoms and the ligand atoms with the angle of deformation of the uranyl entity was set up and solved for the angle of deformation. A value of 18° was obtained. It is believed that the actual bending is greater than the calculated value. (M.C.G.)

25401

THE CHEMISTRY OF THE SOLVATED METAL CHELATES. III. THE BIS-(ACETYLACETONATO)-URANIUM(VI) SOLVATES. Wesley W. Wendlandt, John L. Bear, and G. Robert Horton (Texas Technological Coll., Lubbock). *J. Phys. Chem.* **64**, 1289-91(1960) Sept.

The bis-(acetylacetonato)-uranium(VI) solvates with water, *n*-propyl alcohol, *n*-butyl alcohol, ethyl alcohol, acetone, acetophenone, acetylacetone, dioxane, ammonia, and pyridine were studied by calorimetric and thermogravimetric methods and by differential thermal analysis. The heats of solvation, ΔH_s , for the reaction (where AA is acetylacetone) $UO_2 \cdot (AA)_2(s) + \text{solvate}(l) = UO_2(AA)_2 \cdot \text{solvate}(s)$ were found to be from -3.22 to -20.7 kcal/mole⁻¹. All of the complexes with oxygen-containing solvate molecules were much less stable thermally than those containing nitrogen. In the case of the former, the desolvation was generally a one-step process, followed by the decomposition of the anhydrous complex. With the latter, total disruption of the anhydrous complex immediately followed the desolvation reaction. The differential thermal analysis thermograms showed that in many of the desolvation reactions, two or more endothermic energy changes took place. (auth)

25402

SPECTROPHOTOMETRIC EVIDENCE FOR COMPLEX FORMATION IN THE TRI-*n*-BUTYL PHOSPHATE-WATER-NITRIC ACID SYSTEM. T. J. Collopy and J. F. Blum (National Lead Co. of Ohio, Cincinnati). *J. Phys. Chem.* **64**, 1324-7(1960) Sept.

Tri-(normal)-butyl phosphate solutions containing varying concentrations of nitric acid were investigated to determine the stoichiometry and stability of the complexes formed in the reaction between the two. Spectra data in the range 260 to 320 mμ showed that tri-*n*-butyl phosphate and associated nitric acid reacted to form a stable equimolar complex. Evidence is presented which indicates that additional stable complexes having different mole ratios were not formed. This work demonstrated the complex which is present in the tri-*n*-butyl phosphate phase, and enabled the interpretation of data that were obtained for the two-phase tri-*n*-butyl phosphate-water-nitric acid system. The significance of this complex can be found in its direct application to metal extraction processes, and an understanding of the fundamental chemistry underlying these processes. (auth)

25403

EQUILIBRIUM CONSTANTS FOR THE SYSTEM TRI-*n*-

BUTYL PHOSPHATE-WATER-NITRIC ACID. T. J. Collopy and J. H. Cavendish (National Lead Co. of Ohio, Cincinnati). *J. Phys. Chem.* **64**, 1328-30(1960) Sept.

The equilibrium constant for the reaction of tri-*n*-butyl phosphate with associated nitric acid was calculated to be 19.9 ± 0.5 . The equilibrium distribution constant for the partition of associated nitric acid into tri-*n*-butyl phosphate was determined as 0.19. The equilibrium constants obtained were used to calculate the concentration of associated nitric acid in dilute aqueous nitric acid solutions. These calculations were made from the equilibrium distribution curve for nitric acid between tri-*n*-butyl phosphate and water at 25° over the concentration range of 0 to 12M aqueous nitric acid. (auth)

25404

THE AFFINITY OF CERTAIN DISUBSTITUTED AMIDES AND ORGANOPHOSPHORUS COMPOUNDS FOR WATER. T. H. Siddall, III (E. I. du Pont de Nemours & Co., Aiken, S. C.). *J. Phys. Chem.* **64**, 1340-1(1960) Sept.

The solubility of water in various esters that contain phosphorus and certain disubstituted amides was investigated. Results indicated that the affinity of these materials for water was very strong and depended on the degree of steric hindrance around the dipole group. The order of affinity for water of the phosphate compounds was phosphinate > phosphonate > phosphate. (M.C.G.)

25405

STUDIES OF THE CHEMISTRY OF FISSION PRODUCTS IN MOLTEN SALT POWER REACTOR SYSTEMS. George M. Watson (Oak Ridge National Lab., Tenn.). *Texas Eng. Expt. Sta. Misc. Publ. E 72-60* 10-11(1960) Apr.

The rare-gas solubilities investigated have indicated that xenon and krypton have low solubilities with negative temperature coefficients in molten fluoride mixtures. In view of these findings these two nuclear poisons should pose no serious chemical or engineering problems in their removal on stream as gases. Work on mixed rare-earth fluoride solubilities shows that a rare-earth poison depletion process from a molten fluoride fuel by solid-solvent extraction is chemically feasible. The separation of uranium from fission products by fractional precipitation of oxide phases is chemically feasible. This procedure continues to be investigated with the hope of adapting it to the removal and recovery of traces of uranium from LiF-ThF₄ mixtures as might be used in a two-region molten fluoride breeder reactor. (auth)

25406

POLAROGRAPHIC INVESTIGATION OF CADMIUM CHLORIDE IN AQUEOUS METHANOL, METHANOL, AND AQUEOUS ETHANOL SOLUTIONS. Ya. I. Turyan and B. P. Zhantalai (Kishinev State Univ., Moldavian SSR). *Zhur. Neorg. Khim.* **5**, 1748-55(1960) Aug. (In Russian)

The composition and stability of cadmium chloride complexes in aqueous, aqueous-methanol, methanol, and aqueous-ethanol solutions at constant ionic strengths of $\mu = 0.01$ and 2.0 were analyzed by polarographic methods. Complexes of $(CdCl_4)^{2-}$ and $(CdCl_5)^{3-}$ appear simultaneously with $(CdCl_2)$, $(CdCl_3)^-$, and $(CdCl)^+$ in mixed and nonaqueous solutions at $\mu = 2$. A variation in complex concentration with dielectric constant was observed in aqueous-methanol solutions at $\mu = 2$. Changes in the complexes from $(CdCl)^+$ in H₂O to $(CdCl)^+$, $(CdCl_2)$, and $(CdCl_3)^-$ in 100% CH₃OH and 97.4% C₂H₅OH were noticed at an ionic strength of $\mu = 0.01$. Correlations of the data with published data show that stoichiometric instability constant variations with increased ionic strength pass through a maximum in the region $\mu = 0.5$ to 2.0. The linear dependence of $pK - 1/\epsilon$ (K_1 , K_2 , K_3 , K_4) at $\mu = 2$ and K_1^0 and K_2^0 was confirmed. The

stabilities of the complexes are considerably increased with the increase of nonaqueous dilute. The deviation of $pK - 1/\epsilon$ from linearity increases with the increased complex coordination number. The effective ion radius was found to be $r = r_{Cd^{2+}} \approx r_{Cl^-} \approx r_{CdCl^+}$. It is shown that the function $pK - 1/\epsilon$ can be described by solvation electrolytic theory. (R.V.J.)

25407

THE KINETICS OF $F_3B:NH(CH_3)_2$ HYDROLYSIS. I. G. Ryss and S. L. Idel's (Dnepropetrovsk Inst. of Transportation, USSR). *Zhur. Neorg. Khim.* **5**, 1756-60(1960) Aug. (In Russian)

The preparation and properties of $F_3B:NH(CH_3)_2$ were studied. The hydrolysis of $F_3B:NH(CH_3)_2$ is a reaction of the first order following the mechanism S_N1 . The hydrolysis rate constant (in min^{-1}) as a function of temperature is described by the equation $\lg (0.4343 k) = 16.21 - 6972/T$; the hydrolysis activation energy E is 31.9 kcal, the activation entropy ΔS^\ddagger is equal to 7.2 entropy units. F^- ions accelerate $F_3B:NH(CH_3)_2$ hydrolysis. The $F_3B:NH(CH_3)_2$ decomposes rapidly in strongly alkali atmosphere. The reaction mechanisms OH^- and F^- are similar to the previously studied hydrolysis of BF_3 with ammonia and methylamine. (R.V.J.)

25408

THE KINETICS OF $F_3B:N(CH_3)_3$ HYDROLYSIS. I. G. Ryss and S. L. Idel's (Dnepropetrovsk Inst. of Transportation, USSR). *Zhur. Neorg. Khim.* **5**, 1761-7(1960) Aug. (In Russian)

The synthesis and analysis of pure $F_3B:N(CH_3)_3$ are described. The hydrolysis of $F_3B:N(CH_3)_3$ is a first order reaction which does not accelerate in alkaline medium and is not catalyzed by H^+ ions. The hydrolysis rate (in min^{-1}) constant as a function of temperature is expressed by $\lg (0.4343 k) = 14.52 - 5915/T$; the energy and hydrolysis activation entropy is 27.1 kcal/mol and 0.6 entropy units. The hydrolysis rate is inhibited by high salt concentrations. (R.V.J.)

Analytical Procedures

25409 CEA-1541

France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay.

L'ANALYSE SPECTROGRAPHIQUE DU PLUTONIUM. (Spectrographic Analysis of Plutonium). J. Artaud, M. Chaput, and J. Robichet. 1960. 47p.

Methods for the spectrographic determination of impurities in plutonium are considered. Applications of the "copper spark" method, sparking on graphite, and fractional distillation in the arc are described. (C.J.G.)

25410 CEND/2401/MD/44

Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.

DISSOLVED OXYGEN—INDIGO-CARMINE METHOD. P. F. Santoro and A. S. Powell. Nov. 3, 1959. 2p. OTS

The indigo-carmin method is a simple, rapid, accurate colorimetric procedure for determining small amounts of dissolved oxygen in water (0 to 50 ppm). A solution of reduced indigo-carmin dye added to a water sample is oxidized by the presence of any dissolved oxygen and changes color. The change in color of the dye is directly proportional to the amount of dissolved oxygen present in the sample and can be determined by using a Johnson color comparator. (W.L.H.)

25411 GML-176

Union of South Africa. Government Metallurgical Lab., Johannesburg.

A STUDY OF THE THIOCYANATE METHOD OF URANIUM ANALYSIS FOR PLANT CONTROL PURPOSES. Progress Report. R. E. Robinson, P. J. Urban, and R. G. Velthuis. May 1954. Decl. Aug. 29, 1960. 11p.

A modified thiocyanate method of uranium analysis for use in plant-control work is described. The method is accurate, capable of detecting breakthrough, and rapid. An analysis can be performed by plant operators, without the necessity for accurate measurement of sample or reagent volumes, in less than 3 min. (auth)

25412 PG-Report-149

United Kingdom Atomic Energy Authority. Production Group. [Chemical Services Dept.], Windscale, Sellafield, England.

METHODS FOR THE CONCENTRATION OF ALKALI METALS FROM WINDSCALE RAW MATERIALS PRIOR TO SPECTROGRAPHIC ANALYSIS BY THE LUNDEGARDH AND FLAME PHOTOMETRIC TECHNIQUES. 1960. 8p.

Some materials are decomposed by evaporation, ignition, electrolysis, or bromination, and their residues are dissolved in acid; others are directly dissolved in acid. The solutions are analyzed by Lundegardh or flame photometric techniques. (auth)

25413 TID-6417

Michigan Chemical Corp., St. Louis, Mich.

DETERMINATION OF YTTRIUM AND RARE EARTHS IN MIXTURES. Report 177. Period [covered]: July 9, 1957 to July 21, 1958. R. R. Freeman, Jr. July 29, 1958. 31p. Project No. 942. OTS.

An x-ray fluorescence method, employing direct scaling, was developed for determining yttrium and rare earths in rare earth mixtures. (C.J.G.)

25414 TID-6419

Michigan Chemical Corp., St. Louis, Mich.

SPECTROGRAPHIC ANALYSIS OF IMPURITIES IN PURE YTTRIUM OXIDE. III. STUDIES ON SELECTIVE VOLATILIZATION. Report 200. Period [covered]: September 12, 1958 to November 3, 1958. A. B. Whitehead. Nov. 19, 1958. 7p. Project No. 942. OTS.

Studies on the accuracy of spectrographic analysis of impurities in Y_2O_3 by selective volatilization are described. (C.J.G.)

25415 TID-6421

Michigan Chemical Corp., St. Louis, Mich.

SPECTROGRAPHIC ANALYSIS OF IMPURITIES IN PURE YTTRIUM OXIDE (REVISED METHOD). Report 121. Period [covered]: October 4, 1957 to December 6, 1957. A. B. Whitehead. Dec. 10 1957. Revised Jan. 7, 1958. Decl. Feb. 6, 1959. 16p. Project No. 942. OTS.

A spectrographic method for the determination of Dy_2O_3 , Tb_2O_3 , and Gd_2O_3 in high purity Y_2O_3 and the quantitative estimation of 16 other impurities were devised. The region 2550 to 4350 Å is recorded in the second order. Samples are mixed 1:1 with graphite powder and burned in a graphite electrode. (C.J.G.)

25416 TID-6423

Michigan Chemical Corp., St. Louis, Mich.

THE SPECTROPHOTOMETRIC ANALYSIS OF RARE EARTH MIXTURES. Report 106. Period [covered]: February 25 to August 30, 1957. C. G. Shultz. Oct. 24, 1957. Decl. Feb. 6, 1959. 6p. Project No. 942. OTS.

A method of analysis is described by which praseodymium, neodymium, samarium, dysprosium, holmium,

erbium, thulium, and ytterbium can be determined. Determination of the remainder of the rare earths by difference is complicated by the fact that more than one of those exhibiting no absorption spectrum may be present. The most satisfactory results are obtained with the use of perchloric acid solutions. Nitrate solutions give high results in many cases. The presence of cerium affects both the solubility and the measurability of the samples. (auth)

25417 TID-6425

Michigan Chemical Corp., St. Louis, Mich.
DETERMINATION OF YTTRIUM IN RARE EARTH CONCENTRATIONS BY X-RAY FLUORESCENCE. Report 105. Period covered: March 13, 1957 to July 26, 1957. C. G. Shultz. Oct. 15, 1957. Project 942. Decl. Feb. 6, 1959. 7p. OTS.

An x-ray fluorescence method for determining yttrium in rare-earth concentrates is described. SrCO_3 was employed, in a 2:1 ratio by weight, as an internal standard. (C.J.G.)

25418 TID-6426

Michigan Chemical Corp., St. Louis, Mich.
A SPECTROPHOTOMETRIC DETERMINATION OF SILICA IN HIGH PURITY YTTRIUM OXIDE. Report 102. Period [covered]: August 16, 1957 to September 11, 1957. R. E. Brandt. Sept. 30, 1957. Decl. Feb. 6, 1959. 6p. Project No. 942. OTS.

A spectrophotometric determination of SiO_2 in high purity Y_2O_3 is described which involves reduction of the silico-molybdate solution with 1,2,4-aminonaphthol sulfonic acid to molybdenum blue. (C.J.G.)

25419 TID-6431

Michigan Chemical Corp., St. Louis, Mich.
SPECTROGRAPHIC METHOD OF ANALYSIS FOR YTTRIUM IN ORES. Report 77. Period covered: December 3, 1956–March 1, 1957. A. B. Whitehead. Apr. 27, 1957. Decl. Feb. 6, 1959. 14p. Project No. 942. OTS.

A spectrographic method of analysis of ores for yttrium requiring no chemical rare-earth-group separation is presented. Experiments and data are recorded, along with detailed conditions and procedure. The method requires a minimum of sample preparation, involving only grinding, dilution with CeO_2 and graphite, and loading into electrodes. CeO_2 is used as internal standard. Line pairs used are Y3200.270/Ce3189.638 and Y4358.726/Ce4362.444. Arc excitation using direct current at 17–18 amps is used, and a rotating step-sector is employed to insure measurable line intensity. Accuracy and precision is $\pm 0.18\%$ Y_2O_3 at the 2% level, and $\pm 0.6\%$ Y_2O_3 at the 10% level. (auth)

25420 TID-6432

Michigan Chemical Corp., St. Louis, Mich.
THE ANALYSIS OF ORES FOR YTTRIUM BY X-RAY FLUORESCENCE. Report 76. Period [covered]: January 14 to April 23, 1957. C. G. Shultz. Apr. 25, 1957. Decl. Feb. 6, 1959. 9p. Project No. 76. OTS.

In order to obtain a rapid indication of the presence of yttria earths in ores, a method was devised by which the yttrium content of ores is determined by x-ray fluorescence, using strontium as internal standard. Analysis of ores of known yttrium composition were made, and recovery and dilution experiments run, with average deviations ranging from $\pm 2\%$ at the 35% level to $\pm 0.1\%$ at the 5% level. Thallium, antimony, and tin may interfere to a slight extent if present in high concentrations; lead, rubidium, and iodine will interfere at low concentrations. All these will tend to give a high yttrium value. Niobium exerts a significant effect even at low concentrations, resulting in a low

yttrium value. If these are found to be present, it is necessary to resort to a spectrographic determination. (auth)

25421 TID-6433

Michigan Chemical Corp., St. Louis, Mich.
SPECTROGRAPHIC ANALYSIS OF IMPURITIES IN PURE YTTRIUM OXIDE. Report 87. Period [covered]: March 1, 1957 to May 30, 1957 and July 1, 1957 to July 15, 1957. A. B. Whitehead. July 19, 1957. Decl. Feb. 6, 1959. 8p. Project No. 942. OTS.

A spectrographic method for the detection and determination of rare earth impurities in Y_2O_3 is described. Graphite electrodes are employed with a 1:1 charge of sample to graphite powder. (C.J.G.)

25422 TID-6525

Connecticut. Univ., Storrs.
ANALYTICAL CHEMISTRY AT LOW CONCENTRATIONS. Annual Report No. 4. John T. Stock and M. A. Fill. Aug. 26, 1960. 31p. Contract AT(30-1)-1977. OTS.

Studies on the polarography of the quinolinemonocarboxylic acids and on the microdetermination of 2,2-dinitropropane in mixtures with mononitropropanes are reported. Progress was made in certain other directions such as in the design of simple electromagnetically operated burette valves and in the investigation of the argentometric amperometric determination of cyanide. Some preliminary investigations were made concerning the possibility of measuring by voltammetric means the rate of fission of nitrite ion from mononitroparaffins under hydrolysis conditions. (auth)

25423 TID-7015(Suppl.2)

Oak Ridge National Lab., Tenn.
OAK RIDGE NATIONAL LABORATORY MASTER ANALYTICAL MANUAL. May 1960. 621p. OTS.

Procedures are given for ionic, radiochemical, spectrographic, and nuclear analysis for a number of elements and compounds. (W.L.H.)

25424 UCRL-6020

California. Univ., Livermore. Lawrence Radiation Lab.
MICRO DETERMINATION OF CARBON IN METALS. Jack W. Frazer and Richard T. Holzmänn. June 1960. 7p. Contract W-7405-eng-48. OTS.

Carbon in metals can best be determined by high-temperature oxidation of the sample and subsequent measurement of the evolved carbon dioxide. An apparatus and procedure are described which constitute a modification of a capillary-trap determination method. The modification resulted in a simplified portable apparatus (20 in. wide, 15 in. deep, and 42 in. high). The method is applicable to metals with high sulfur and nitrogen content. (auth)

25425 CEA-tr-A-624

COMPLEXOMETRIE DES TERRES RARES. (Complexometry of the Rare Earths). L. Holleck, D. Eckardt, and L. Hartinger. Translated into French from *Z. anal. Chem.* 146, 103-7(1955). 10p.

A complexometric method is described for determination of rare earths. The formation of colored lakes is avoided by using complexones. In adjusting the concentrations, the regions where the Lambert-Beer law is valid were observed. This method permits determination of quantities of about 6×10^{-6} g/ml. (tr-auth)

25426 CEA-tr-R-849

NOUVEAU GÉNÉRATEUR D'ARC DOUBLE POUR L'ANALYSE SPECTROCHIMIQUE. (New Double-arc Generator for Spectrochemical Analysis). Pên-li Huang (Kuan-Bun-Li). Translated into French from *Zavodskaya Lab.* 24, 348-52(1958). 13p.

An improved double-arc apparatus is described which offers the advantages of parallel connection with separate controls and a low-voltage condenser for variable excitation. The latter feature permits determination of certain metalloids, the halogens, sulfur, and such materials. The apparatus is demonstrated in determinations of Zn, Cl, and Br. (T.R.H.)

25427

CONTROL OF THE PURITY OF WATER SAMPLES USED FOR THE DENSITOMETRIC ISOTOPIC ANALYSIS BY ELECTRICAL CONDUCTIVITY MEASUREMENTS. Mircea Pașcalău, Liviu Blaga, Lucia Blaga, and Alexandra Chifu. *Acad. rep. populare Romîne, Inst. fiz., atomică și Inst. fiz. Studi cercetări fiz.* 11, No. 1, 228-30(1960). (In Rumanian)

Conductometric analyses were performed on pure water samples that had a specific conductivity of $2.5 \times 10^{-6} \Omega^{-1} \text{cm}^{-1}$ for checking their isotopic composition. In order to eliminate polarization effects, a current source of 1300 cycles and 1.5 volts was used in connection with the Wheatstone bridge covering 5 decades from 100 Ω to 5 M Ω . The cell constant was determined by calibration with 0.001 N KCl solution. The method is very useful for quality control of purified samples. (TTT)

25428

TREATMENT OF RADIOLYSIS GAS IN A REACTOR COOLED OR MODERATED BY WATER. P. Vignet. *Bull. inform. sci. et tech. (Paris)* No. 40, 48-60(1960) May. (In French)

In reactors water dissociates into oxygen and hydrogen under the effect of radiation. For nonpressurized heterogeneous reactors the radiolysis rate is low, but greatly affected by the water purity. A degassing apparatus is necessary, and a recombiner is needed when a costly liquid such as heavy water is used. The recombiner uses a heterogeneous catalyst. For homogeneous reactors the radiolysis rate is high, but quite predictable. The radiolysis products are recombined "in situ" by a homogeneous catalyzer, of which cupric ion is the best. (tr-auth)

25429

SPECTROPHOTOMETRIC DETERMINATION OF NICKEL BY MINERAL ACID. Tsunenobu Shigematsu, Yuroku Yamamoto, Masayuki Tabushi, and Toyokichi Kitagawa. *Bull. Inst. Chem. Research, Kyoto Univ.* 38, 307-12(1960) July. (In English)

The spectrophotometric determination of nickel was studied by using various mineral acids such as hydrochloric, perchloric, and sulfuric acid as reagents. The absorption spectra were measured for the cobaltous perchlorate at various concentrations of each acid solution and it was found that the spectra were quite similar in the cases of perchloric acid and sulfuric acid solution. This was attributed to the existence of cobaltous aquo ion. In the hydrochloric acid medium, the spectra were more complicated, showing bathochromic and hyperchromic effects as the increase of the concentration of the hydrochloric acid, and the result was ascribed to the successive formation of chloro-complexes. The calibration curves for cobalt were made at appropriate wavelengths in each acid solution and Beer's law was obeyed in the range 0.05 to 0.3M. The proposed method for the determination of cobalt is simple in procedure but has a low sensitivity. (auth)

25430

QUANTITATIVE ESTIMATION OF SLIGHT ADMIXTURES OF RARE-EARTH ELEMENTS BY SPECTRAL ANALYSIS WITHOUT THE USE OF A REFERENCE STANDARD. Yu. I. Belyaev (Vernadskii Inst. of Geochemistry and

Analytical Chemistry, Academy of Sciences, USSR).

Doklady Akad. Nauk S.S.S.R. 133, 95-7(1960) July 1. (In Russian)

A method of spectral line comparison is suggested for determining small quantities of rare-earth admixtures in pure rare-earth elements. Tabulated data for small quantities of thulium in erbium and europium in gadolinium, determined without a reference standard, indicate an order of mean quadratic error of ± 15 to 20% per determination. (R.V.J.)

25431

APPLICATION OF ION-EXCHANGE CHROMATOGRAPHY FOR THE DETERMINATION OF THE POLYMERIZATION FACTOR OF ZIRCONIUM IN SOLUTIONS. A. K. Babko and B. I. Nabivanets (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). *Dopovidi Akad. Nauk Ukr. R.S.S.R.* No. 5, 646-8(1960). (In Ukrainian)

The process of ionic exchange on cationites obeys the law of acting masses; therefore the equilibrium shift method which allows determination of the coefficients in chemical reaction equations may be applied. The ionic exchange of zirconium on the cationite may be represented by the formula $\text{paRH} + \text{Zr}^{4+} = \text{pR}_4\text{Zr} + \text{faH}^+$. Under the condition $[\text{H}^+] = \text{constant}$ and $[\text{RH}] = \text{constant}$ the quantity of zirconium [g] absorbed by the cationite is a function of the total analytical concentration (c) in the solution. A graphic representation of the dependence $\log g = f(\log c)$ was used to determine the polymerization factor p, equal to the tangent of the angle of inclination of this dependence (with an equal scale of value). A study of the effect of the zirconium concentration on its absorption by cationite KY-1 from chloric solutions showed that the polymerization factor rises on increasing the concentration of zirconium and lowering the acidity of the medium. (auth)

25432

A NEW GEOCHEMICAL METHOD FOR THE DETERMINATION OF MOLYBDENUM IN SOIL AND ROCK. J. Kent Perry (Colorado School of Mines Research Foundation, Inc., Golden). *Econ. Geol.* 55, 1232-1243(1960) Sept.-Oct.

A new geochemical method for the determination of molybdenum in soil and rock is given. Tungsten, chemically similar to molybdenum, does not react with the colorimetric reagent. The method can be used without modification for determining a much wider range of molybdenum than the commonly used thiocyanate method. The method is based on carbonate-nitrate fusion of the sample and subsequent aqueous leaching, which remove elements that form insoluble hydroxides. A further separation of molybdenum from interfering elements is effected by solvent extraction with amyl acetate, followed by aqueous stripping. A colored complex molybdenum exanthate compound is formed by the addition of potassium ethyl xanthate, extraction into benzene, and comparison with standards. Approximately 30 determinations can be made per man day. The test can be used in a field camp with the use of portable heat sources. Radiochemical tracer techniques show that 45% of the molybdenum present in the sample aliquot is recovered as colored complex. This loss, however, is partially or wholly compensated for since standards are subjected to the same procedure. Standard deviation for the method was found to be $\pm 6.3\%$ error. The greatest error is caused by incomplete and inconsistent decomposition of silicate materials in the sample. This error appears to be of the same order of magnitude for both the thiocyanate method and the new xanthate method presented in this paper. (auth)

25433

RADIOMETRIC THALLIUM DETERMINATION WITH Co^{60} -

LABELLED COBALT HEXAMMINETRICHORIDE.

H. Koch (Institut für Angewandte Radioaktivität, Leipzig).

Kernenergie 3, 609-12(1960) July. (In German)

Trivalent thallium ions form difficultly soluble compounds with cobalt hexamminetrichloride. Labeling the reagent with Co^{60} makes possible a relatively simple method for thallium titration. It is shown that <1 mg of thallium is taken up, and perfect titration curves are produced by determining two points. (tr-auth)

25434

A MICROAUTORADIOGRAPHIC METHOD FOR DETERMINATION OF THE DISTRIBUTION OF SILICIC ACID FILLER IN RUBBER. W. Herrmann, G. Hartmann, H.-K. Bothe, and G. Hofmann (Institut für Angewandte Radioaktivität, Leipzig). *Kernenergie* 3, 663-5(1960) July. (In German)

A method is described which was developed for autoradiographic study of the distribution of silicic acid filler in rubber. The method involves adsorption of $\text{P}^{32}\text{O}_4^{3-}$ ions on the rubber samples by soaking them in an aqueous solution for two days. (T.R.H.)

25435

THE DETERMINATION OF TRACE ELEMENTS BY NEUTRON ACTIVATION ANALYSIS. W. T. Mullins and G. W. Leddicotte (Oak Ridge National Lab., Tenn.). *Texas Eng. Expt. Sta. Misc. Publ. E 72-60* 5-9(1960) Apr.

The neutron radioactivation analysis program at the Oak Ridge National Laboratory is described. The principles of the neutron radioactivation analysis method are briefly described. The advantages and limitations of activation analysis as compared to other methods are discussed. The application of activation analysis to the determination of oxygen, argon, and sulfur is shown. The use of activation analysis in the determination of elements in macro concentration and in particle-size distribution is described. (W.L.H.)

25436

DETERMINATION OF TUNGSTEN IN NIOBIUM-CONTAINING ALLOYS. I. P. Kharlamov, P. Ya. Yakovlev, and M. I. Lykova (Bardin Central Scientific Research Inst. of Ferrous Metallurgy, USSR). *Zavodskaya Lab.* 26, 786-7(1960). (In Russian)

It was found that the solution obtained by leaching out with water the melt of tungstic, silicic, and niobic acids with K_2CO_3 may be used not only for the determination of niobium but for tungsten analysis as well. The determination is best performed after the chromatographic separation from niobium, which is adsorbed on Al_2O_3 from alkaline solution in the form of niobium hexaniobate, while the tungsten passes into the filtrate. The niobium can be extracted only by acid complexing agents such as oxalic acid and H_2O_2 ; the tungsten is determined by the thiocyanate method. (TTT)

25437

DETERMINATION OF MICRO-IMPURITIES CONTAINED IN SILICON BY THE GAMMA-SPECTRA OF THEIR RADIOACTIVE ISOTOPES. K. I. Erokhina, I. Kh. Lemberg, I. E. Makasheva, I. A. Maslov, and A. P. Obukhov (Physico-Technical Inst., Academy of Sciences, USSR). *Zavodskaya Lab.* 26, 821-7(1960). (In Russian)

In searching for a method for determining the impurities in silicon semiconductors without dependence on the purity of the reagents used, the γ radiation of activated isotopes was found to present good promise. The linear character of the γ spectra obtained with a scintillation spectrometer allowed qualitative and quantitative determination of the impurity elements. The samples were activated by exposing them to a thermal neutron flux of about 9×10^{12} neutrons/

$\text{cm}^{-2}/\text{sec}^{-1}$. The presence of a number of elements in concentrations down to $10^{-1}\%$ was thus established in "high-purity" silicon samples. The sensitivity of the method allowed the determination of amounts of certain elements as small as 10^{-11} g. As no preliminary chemical separation is necessary, the method could be used for quality control of semiconductor samples. (TTT)

25438

EXPERIMENTAL METHOD FOR DETERMINING THE ASH CONTENT OF COAL BASED ON THE REFLECTION OF β -RADIATION. R. A. Irkovskii (Ostrava Mining Inst., Czechoslovakia). *Zavodskaya Lab.* 26, 832(1960). (In Russian)

Instead of using the time-consuming gravimetric method or γ -ray absorption, the ash content of coals was determined from the reflected β radiation. This is possible because the main components of coal itself are light elements, such as C, H, O, and N, whereas the ash contains elements having higher atomic numbers such as Si, Al, Fe, Ca, and Mg; and accordingly the intensity of the reflected β radiation is a function of the ash content. The studies were made by using a Sr^{90} - Y^{90} source and an ionization chamber with a d-c amplifier. The reflected radiation passed through an attenuating aluminum filter; the actual concentration could be calculated by comparing experimental data with those obtained using a reference standard. While the particle size variation between the limits of 0.3 to 0.75 mm did not influence the results, the moisture content affected the data, making it necessary to dry the samples before analysis. (TTT)

25439

POLAROGRAPHIC STUDIES OF HEXAVALENT URANIUM SULFURIC ACID SOLUTIONS. E. A. Kanevskii and G. R. Pavloskaya. *Zhur. Neorg. Khim.* 5, 1738-42(1960) Aug. (In Russian)

The reduction and disproportionation of uranium in sulfuric acid solutions were analyzed by polarographic methods. With considerable variation in diffusion currents, corresponding to the $\text{U(VI)} \rightarrow \text{U(V)}$ and $\text{U(V)} \rightarrow \text{U(IV)}$ reduction, their sum is a constant in 0.02 to 1.0 N H_2SO_4 . The viscosity decreases as the $\text{U(VI)} \rightarrow \text{U(V)}$ first wave i_d in transition from 2 to 4 N H_2SO_4 . However the reduction in the i_d of the third wave cannot be referred to the same factor. It is shown that $E_{1/2}$ of the second wave corresponding to $\text{U(V)} \rightarrow \text{U(VI)}$ is a linear function of mean sulfuric acid activity. (R.V.J.)

General Inorganic and Physical Chemistry

25440 AD-234910

Pavia, Italy. Università. Istituto di Fisica Superiore. RECENT RESULTS ON NUCLEAR MAGNETIC RELAXATION. Final Technical Report [for] March 1959-February 1960. G. Bonera, L. Chiodi, L. Giulotto, G. Lanzi, and A. Rigamonti. Feb. 1960. 39p. Contract DA-91-591-EUC-1058.

A theoretical work in which adiabatic passage structure in nuclear magnetic resonance is examined by the rotating coordinate method is presented. An experimental work which mainly concerns the comparison between the longitudinal and transversal relaxation time in pure liquids is also included along with some results recently obtained on nuclear relaxation in colloidal solutions. (auth)

25441 NLCO-814

National Lead Co. of Ohio, Cincinnati.

THERMAL DECOMPOSITION OF URANYL SULFATE

(thesis). Karl J. Notz, Jr. Mar. 1960. 45p. Contract AT(30-1)-1156. OTS.

Submitted to the Univ. of Cincinnati.

The thermal decomposition of UO_2SO_4 to U_3O_8 was investigated by means of differential thermal analysis (DTA) and both isothermal and nonisothermal thermogravimetric analysis (TGA). It was found that dehydration of $\text{UO}_2\text{SO}_4 \cdot 3\text{H}_2\text{O}$, the usual commercial form, occurs in three steps, with the intermediate formation of the dihydrate and the monohydrate. Decomposition of UO_2SO_4 to U_3O_8 , oxides of sulfur and oxygen was observed at 690 to 830°C. The decomposition is reversible and the decomposition temperature varies with atmosphere. In air, calcining to constant weight of 750° yields stoichiometric U_3O_8 . In correlating DTA and TGA decomposition temperatures, the large influence exerted by the effective atmosphere was observed. It was established that in conventional DTA the effective atmosphere is composed of the decomposition gases. Therefore, TGA data should be obtained in a similar atmosphere if correlation of the two methods is desired. The methods of UO_2SO_4 decomposition in an inert atmosphere was studied. The rate of reaction was deduced to be limited by both nucleation and growth. The derived rate expression, in terms of mg of weight lost per min per m^2 of active surface is: $\text{Rate} = 11 \times 10^4 e^{-58,600/RT}$. (auth)

25442 NP-9145

Brooklyn. Polytechnic Inst.

SYNTHESIS AND EVALUATION OF NEW POLYMERS

PREPARED BY STEREOSPECIFIC CATALYSIS. Quarterly Progress Report [for] April 1 to June 30, 1960. Charles G. Overberger. 30p. Project No. 7340. Contract AF33 (616)-6866.

4-Trifluoromethylpentene-1 and 5,5,5-trifluoropentene-1 were prepared but were not obtained in a pure state. The change of transmittance with time was found to be useful for following the rate of polymerization of trifluoromethacrylonitrile in dimethylformamide initiated with sodium cyanide. Pure methylenecyclopropane could not be obtained from the reaction of magnesium metal on 3-chloro-(2-chloromethyl)-1-propane. Methylenecyclobutane was polymerized with a cationic catalyst. Cyclobutylcarbinol was dehydrated with 20% sulfuric acid to yield cyclopentene. Cyclopropylcarbinol was dehydrated with 50% sulfuric acid to yield 1,3-butadiene. Styrene was polymerized with stannic chloride in nitrobenzene-carbon tetrachloride. Viscosity and weight average molecular weights were determined. Number average molecular weights have not yet given reliable results. Styrene, *p*-tert-butylstyrene, and *o*-methylstyrene were polymerized with the Natta catalyst and the polymer's crystallinity investigated by x ray. Radioactive styrene was copolymerized with *p*-tert-butylstyrene and *o*-methylstyrene. The system potassium-diglyme-methacrylonitrile was found to be unsuitable for kinetic studies. (For preceding period see NP-8739.) (auth)

25443 NYO-8098

Johns Hopkins Univ., Baltimore.

ABSORPTION AND FLUORESCENCE SPECTRA OF URANIUM SALTS AND OTHER SOLIDS; SPECTRA OF MOLECULES CONTAINING TRITIUM IX. Annual Report. G. H.

Dieke. June 18, 1959. 12p. Contract AT(30-1)-1447. OTS.

Work is reported on the absorption and fluorescence spectra of the crystalline salts of rare earths and actinides. Work was also performed on the spectrum of the hydrogen molecule and its isotopic species. (W.L.H.)

25444 ORNL-2983(p.8-11)

Oak Ridge National Lab., Tenn.

ISOLATION AND CHEMICAL PROPERTIES OF SYNTHETIC ELEMENTS. R. H. Busey and R. B. Bevan, Jr.

The solubilities at 25°C of KTcO_4 in water and of K_2ReCl_6 in 0.0100 M HCl were determined to be 0.1057 m and 0.1664 m. The standard heats of solution were measured calorimetrically as 12,765 and 10,397 cal/mole. The entropies of the ions were computed to be $S^\circ[\text{TcO}_4^- (\text{aq})] = 47.9 \text{ cal} \cdot \text{deg}^{-1} \cdot \text{mole}^{-1}$ and $S^\circ[\text{ReCl}_6^{2-} (\text{aq})] = 59.5 \text{ cal} \cdot \text{deg}^{-1} \cdot \text{mole}^{-1}$. The visible and near-infrared spectrum of K_2ReCl_6 in 1 M HCl is presented and the vibrational fine structure exhibited is discussed in relation to the excess entropy of K_2ReCl_6 over that of K_2PtCl_6 . Reduction of TcO_4^- in HCl solutions with zinc metal produces two species of technetium(III), one in high acidities and one in low acidities. Evidence is given to suggest the species are TcCl_4^- and $\text{Tc}(\text{OH})\text{Cl}_3^-$ respectively.

25445 ORNL-2983(p.44-53)

Oak Ridge National Lab., Tenn.

CHEMISTRY OF AQUEOUS SYSTEMS. W. C. Waggener, A. J. Weinberger, et al.

Solutions of UO_2SO_4 and CuSO_4 in D_2O were investigated spectrophotometrically from 4 to 280°C. The 0.42- μ band of U(VI) and the 0.82- μ band of Cu(II) showed monotonic increases in absorptivity by factors of 2.3 and 2.0, respectively, over this temperature range. A solution containing both U(VI) and Cu(II) showed a small amount of U(IV) to be present below 50°C after a thermal cycle and to disappear reproducibly on raising the temperature above 50°C. The standard potential of the Ag, AgBr electrode was measured up to 200°C, and the activity coefficient of HBr was determined up to 200°C over the concentration range 0.005 to 0.5 m and to 150° over the range 0.5 to 1.0 m. The standard electrode potentials of the quinhydrone electrode were measured from 25 to 55°C at 5° intervals using an Ag, AgCl reference electrode; the quinhydrone electrode is sufficiently reproducible in this temperature range to be used for activity coefficient measurements. The Beckman amber-glass electrode in conjunction with either an Ag, AgBr or an Hg, Hg_2Br_2 reference electrode was used to measure the activity coefficients of HBr solutions to 100°C. The acid error becomes higher with increasing temperature and acidity, limiting the useful range at 60°C to the millimolar region and below. The solubility of Ag_2SO_4 was measured in UO_2SO_4 solutions to 200°C. The agreement between observed and calculated solubilities was good under all conditions when hydrolysis and complexing of the uranyl ion were taken into account. Single-parameter Debye-Hückel expressions were found to be satisfactory for representing the variation of all the equilibrium quotients with ionic strength throughout the temperature range 25 to 200°C. Activity coefficients of silicotungstic acid (0.0004 to 0.04 M), measured by equilibrium ultracentrifugation, are in satisfactory agreement with the Debye-Hückel theory for a 1-4 electrolyte with a distance of closest approach parameter of 7.6 Å. Turbidities of this system agree with the ultracentrifugation results. Equilibrium ultracentrifugations of soap solutions confirm that, if excess salt concentration is not too high, micelles are predominantly monodisperse; the micellar weights determined by this technique agree fairly well with those given by light scattering. In a continuation of studies of anion exchange resins and their utilization for separations, adsorbability of positively charged complexes by anion exchangers was demonstrated and a new elution method for the removal of strongly adsorbed anions through complexing with cations was developed. The apparent molar

volumes of exchangers in three-component systems were found to be additive. Earlier study on the adsorption of HF by anion exchangers was extended, and the selectivity coefficient of the HF_2^- ion compared with the F^- ion was evaluated, as well as the distribution coefficient of (molecular) HF. For the latter, large differences were found between anion and cation exchangers. Investigations of the ion exchange and stability properties of various inorganic materials continued. The effect of method of preparation on the properties of zirconium phosphate was investigated as well as the stability of various phosphates to acids and bases at high temperature (200°C). Remarkable differences in the stability of zirconium and titanium phosphates to base at high temperatures were found. A survey of the properties of tantalum phosphate was carried out. A combination of two inorganic materials, one highly selective for Cs^+ over Ba^{2+} and one having the reverse selectivity in the same medium, was developed for the rapid separation of short-lived Ba^{137} from its long-lived parent, Cs^{137} . The combination should have applications as a rapidly decaying, mobile radiation source. The results of calorimetric measurements of the heat of the zinc-sodium ion exchange reaction on 2, 4, 8, 16, and 24% DVB Dowex 50 resins are discussed in terms of entropy changes. A rigorous thermodynamic computation of the equilibrium selectivity coefficients for the exchange of bromide with chloride, iodide, or fluoride ions present in dilute aqueous solutions was performed for a series of cross-linked strong-base anion exchangers (polystyrene quaternary ammonium type) using the Gibbs-Donnan equation. Swelling pressures and activity coefficient ratios were evaluated from weight swelling measurements conducted in isopiestic vapor pressure experiments on virtually un-cross-linked and on cross-linked exchangers. Partial molar volume differences needed for the swelling free energy estimate were derived from density measurements on a weakly cross-linked exchanger. In the absence of specific interactions in the aqueous phase, the selectivity coefficient was found to be a function solely of the weight swelling. (auth)

25446 ORNL-2983(p.61-70)

Oak Ridge National Lab., Tenn.

NONAQUEOUS SYSTEMS AT HIGH TEMPERATURE.

G. W. Parker, H. R. Bronstein, et al.

Comparative studies of the rate of reaction of highly irradiated uranium with air, CO_2 , and steam were conducted in an investigation of the fission product release potential in a loss-of-coolant type accident postulated for the plutonium-producing reactors. Highly irradiated uranium was found to be more reactive, probably because of the defects in the oxide coating formed by the inclusion of fission products. Complete oxidation or melting released rare gases, iodine, and tellurium semi-quantitatively in most atmospheres. Other fission products (ruthenium, cesium, and strontium) were released to a lesser extent and apparently in proportion to the amount of self-heating induced. In order of their relative tendency to promote the release of fission products the atmospheric reactants investigated could be rated in the order: air > CO_2 > steam. In pursuit of the study of metal solutions in molten halides, the solubilities of lithium metal in molten lithium chloride and lithium iodide were found to increase between 600 and 1000°C approximately from 0.5 to 1.0 and from 1.2 to 2.5 mole %, respectively; they are the smallest yet observed among the alkali-metal systems. An electrochemical investigation of the Ce-CeCl₃ system was started. The data of the recent literature obtained with the use of alumina crucibles were shown to be entirely erroneous, as the dis-

solved cerium was found to react readily with Al_2O_3 to form CeOCl and aluminum metal. The conductivities of three molten salts, LiI, CsF, and CeCl₃, were found to be quite different from values reported by others, which are thought to be in error. The determination of the heat of fusion of the alkali halides was completed with calorimetric measurements on NaCl and the four rubidium halides. A neutron and x-ray diffraction study of molten cesium fluoride yielded a radial distribution function and an estimate of 3.7 ± 0.1 nearest neighbors of opposite charge at a most frequent distance of 2.85 Å, significantly smaller than the number 6, at 3.12 Å, in the solid at the melting point. On the basis of new x-ray diffraction studies on molten and solid bismuth(I) chloroaluminate, the assumption of a trimeric ion, $(\text{Bi}_3)^{3+}$, was arrived at, which is likely to replace an earlier proposal of a dimeric ion, $(\text{Bi}_2)^{2+}$, thought to occur in $(\text{BiCl})_x$. (auth)

25447 ORNL-2983(p.71-87)

Oak Ridge National Lab., Tenn.

CHEMICAL PHYSICS. R. B. Bevan, Jr., R. H. Busey, et al.

The low-temperature heat capacity of K_2ReBr_8 was measured and the entropy at 298.15°K calculated to be 108.47 cal · deg⁻¹ · mole⁻¹. Enthalpy measurements using a Bunsen ice calorimeter on standard Al_2O_3 are presented for the temperature range 0 to 900°C and are compared with those obtained at the National Bureau of Standards. Work on the characteristics of thermal emission of positive ions from heated tungsten filaments and on the vapor-phase association of alkali halides was completed. The product-detection component of the apparatus used to study the kinetics of the reaction between potassium and potassium bromide was redesigned to improve angular resolution and to eliminate spurious beam effects. A new apparatus was designed and substantially completed to study the hydrogen-deuterium exchange reaction. Anomalous coherent neutron scattering from single crystals was demonstrated for the first time. Friedel's law, which requires $I_{hkl} = I_{\bar{h}\bar{k}\bar{l}}$ for Bragg scattering from single crystals, fails in CdS, CdI₂, and BP, each of which contains strong neutron absorbers. The neutron-scattering amplitude in the thermal range was shown for Cd in CdS and CdI₂ to be energy-dependent. A single-crystal neutron-diffraction study of hydrazine is in progress. Preliminary results indicate that the molecular configuration is probably a staggered one. A single-crystal neutron-diffraction study of $\text{Sr}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$ is being undertaken. The hydroxide ions are hydrogen-bonded to each other in linear chains. A computer program to produce stereoscopic pictures of crystal structures by using the cathode-ray-tube output of the IBM-704 is described. A structure for $\text{Na}_7\text{Zr}_6\text{F}_{31}$ is proposed. The saturation concentration of hydrogen atoms upon prolonged gamma irradiation of 0.129 mole fraction sulfuric acid at 77°K was found to be 3.4×10^{18} atoms per g and that for 0.125 mole fraction perchloric acid was 2.9×10^{19} . The scavenging of atomic hydrogen by nitric acid and by hydrogen peroxide was studied, and an accompanying study was made on the molecular hydrogen yields. The unpaired electron distribution on the two hydrazyl nitrogen atoms of the stable free radical α, α -diphenyl- β -picrylhydrazyl was determined by a detailed study of the anisotropic hyperfine interactions in a single crystal containing a small amount of the radical. A paramagnetic-resonance study of the two species formed in gamma-irradiated single crystals of calcium tungstate at 77°K elucidated many details of the radiation effect. One of these species is electron-deficient and contains two tungsten atoms, while the other has a surplus electron and contains a single atom of tungsten. A paramagnetic-resonance

study is in progress on irradiated single crystals of sodium nitrite containing silver nitrite. Hyperfine effects from N^{14} were measured, and the results are being interpreted on the basis that NO_2 is the most likely paramagnetic species. Molecular association energies in alkali halide vapors were studied by measuring the temperature dependence of the molecular weights of gaseous NaCl, NaBr, NaI, KCl, KI, RbCl, and CsCl. Dissociation energies for the reaction $(MX)_2 \rightleftharpoons 2MX$ at 1300°K ranged from 48.0 kcal/mole for NaCl to 34.7 for CsCl. Free radicals and a stable intermediate displaced from the surface of a platinum catalyst have been identified by studying heterogeneous reactions at high pressure (1 mm) in a research mass spectrometer. Chemical species having unpaired electrons, whether charged (ion-radicals) or uncharged (free radicals), were shown to undergo similar types of reactions. Evidence was found in a negative ion-molecule reaction that rearrangement always involves the migration, or tunneling, of the hydrogen originally attached to the negative ion. The increased yield in the radiolytic polymerization of $(CN)_2$ upon the admixture of xenon is attributed to the observed increase in negative-ion polymers and to the observed addition complex $[Xe(CN)_2]^+$. Charge-transfer reactions producing intrinsic chemical change (methyl, methylene, and hydrogen radicals from CH_4) in the neutral molecule were proved by mass-spectrometric techniques. Mass-spectrometric studies show that numerous radiation-induced charge-transfer reactions between C_2H_2 or CO and chemically inert gases go with high probability. However, not all energetically possible charge-transfer reactions go. Ion-molecule reactions in the alpha radiolysis of C_2H_4 were studied in the alpha-particle mass spectrometer. Both pressure studies and mixture studies were employed to elucidate reaction mechanisms. Polymeric ions as large as $C_2H_5^+$ resulting from tertiary reactions were observed. The charge spectrum of the ions formed after the beta decay of He^6 was found to agree with theoretical expectations. (auth)

25448 ORNL-2993(p.112-28)

Oak Ridge National Lab., Tenn.

HRP THORIA BLANKET DEVELOPMENT.

Twenty-four experimental batches of specification-grade ThO_2 and 19 batches of thorium-uranium oxide were prepared in the new pilot-plant facility. The particles of the mixed oxide lacked integrity, and its preparation was suspended at midyear. Rounded particles of Th-3 mole % U containing 1.6 wt. % Al_2O_3 , 1 to 2 μ in diameter, were prepared by flame denitration. In the 100A loop these gave < 0.1 and 1.3 mpy attack rates and negligible particle degradation when circulated as a slurry at 20 and 40 fps. Yield stresses for the material were a factor of 2 to 4 lower than 1600°C-fired oxide prepared from thorium oxalate. Spherical ThO_2 particles, 0.5 to 30 μ in diameter, were prepared by setting 1.3 to 1.5 M ThO_2 sols to gels in isopropyl alcohol, followed by ammonia-washing, drying, and calcining to 1000°C. Particles with densities up to 8 g/cc were obtained, but they tended to be hollow and to be degraded in jet-abrasion and toroid tests. Three 4-kg batches of rounded thoria pellets which had good integrity and showed < 1 wt. %/hr attrition loss were prepared for studies of the HR pebble-bed blanket. Porous or weak thoria spheres pressed from ceramic-grade powder were strengthened by soaking in thoria sol or dibasic aluminum nitrate solution, followed by firing. Nonspherical thoria bodies, 2 mm in diameter, with high density and strength were prepared by a gel-bead technique. A palladium catalyst for recombination of radiolytic gases formed in aqueous thoria and urania-thoria slurries had a high specific activity in both out-of-pile and in-pile tests. This activity

was not maintained when a large excess of either hydrogen or oxygen was present. Pump-loop experiments under oxygen showed an order of magnitude lower specific activities and an activity half-life of several hundred hours. A new apparatus for laboratory studies was developed in which measured amounts of hydrogen and oxygen could be injected at temperature into the autoclave containing the slurry-catalyst system. The solubilities of hydrogen and oxygen in water and in aqueous 650°C-fired thorium oxide slurries were measured from 27 to 300°C. The presence of the thorium oxide did not affect the hydrogen solubility but resulted in an increase by as much as a factor of 2.3 in the oxygen solubility over what would have dissolved in the water phase alone. With freshly prepared ThO_2 about 2 cc (STP) of oxygen per g of thorium oxide was irreversibly adsorbed. Thorium oxide powders fired at 650, 800, 900, 1100, and 1500°C were irradiated for 16 and 22 months in the LITR at a thermal-neutron flux of 2×10^{13} neutrons $cm^{-2} sec^{-1}$. A marked decrease in surface area for all oxides except the high-fired oxide indicated that irradiation produced about the same sintering effect as firing at 1500°C despite the fact that the temperatures of the powders under irradiation were probably less than 300°C. (auth)

25449 ORNL-2993(p.129-35)

Oak Ridge National Lab., Tenn.

SURFACE CHEMISTRY.

As the first step in studying the adsorption of ions from solution by ThO_2 surfaces, several approaches to producing a suitable sample of ThO_2 were tried. Available theory relates such surface-adsorption measurements to the tendency of slurry particles to flocculate and then to cake. In order to interpret adsorption data, the ThO_2 particles should have no internal surface and should be in a certain size range. Such particles were prepared by the breakdown of multicrystalline ThO_2 particles (produced by thermal decomposition of thorium oxalate) by digestion in warm dilute acid. A sample produced this way will be used for the first adsorption measurements. Several tests were made to determine the behavior of glass electrodes in ThO_2 suspension systems. The results agree with the theoretical contention that a reversible electrode gives the same reading in a suspension as in a supernatant in chemical equilibrium with the suspension. The tests also indicate that a supernatant can react with the atmosphere to give a change in its pH reading. (auth)

25450 ORNL-2993(p.204-6)

Oak Ridge National Lab., Tenn.

CHEMICAL APPLICATIONS OF NUCLEAR EXPLOSIONS.

In order to evaluate the reactions of tritium under the conditions expected from nuclear explosions contained in rock salt, chemical reactions of hydrogen with the impurities found in rock salt were studied. Calcium sulfate is reduced to the sulfide by hydrogen, whereas magnesium sulfate is reduced to the oxide. The reactions proceed at readily measurable rates in the 700 to 900°C range. The rate was lower by a factor of 1.2 to 1.7 when the calcium sulfate was dissolved in liquid sodium chloride. Tritium exchanged between water and molecular hydrogen flowing over calcium sulfate to the extent of about 8% at 700°C when the ratio of H_2 :HTO was 20. The degree of ionization and enthalpy of argon, hydrogen, and nitrogen were calculated for temperatures up to 20,000°K. (auth)

25451 R60SD387

General Electric Co. Missile and Space Vehicle Dept., Philadelphia.

A METHOD FOR THE OBSERVATION OF THE INFRARED

SPECTRUM OF HIGH TEMPERATURE VAPORS BY MATRIX ISOLATION. I. THE INFRARED SPECTRUM OF LITHIUM FLUORIDE. Milton J. Linevsky. June 1960. 18p. Contract AF04(647)-269.

A method for observing the infrared spectrum of matrix-isolated high-temperature vapors, as applied to lithium fluoride, was developed. This method provides a convenient technique for observing the infrared spectrum of high-temperature vapors in equilibrium with a condensed substrate. An apparatus was developed that is capable of obtaining the infrared spectrum of matrix-isolated vapor molecules generated by Knudsen effusion. The fundamental vibrational frequency of lithium fluoride was observed in argon, krypton, xenon, and nitrogen matrices. Shifts in this frequency due to the interactions with the various matrices were explained on a basis of a semiclassical model. (auth)

25452 TID-6436

Michigan Chemical Corp., St. Louis, Mich.
PREPARATION OF PURE EUROPIUM BY ELECTROLYSIS. Report 101. Period [covered]: July 22, 1957 to July 24, 1957. John R. Morton. Aug. 31, 1957. 2p. Project No. 942. OTS.

High-purity Eu_2O_3 was prepared by electrolysis of an acetate-citrate solution of a 30 to 50% Eu_2O_3 concentrate between a platinum-gauze anode and a liquid-mercury cathode. (C.J.G.)

25453 TID-6474

Michigan. Univ., Ann Arbor.
THE FARADAIC ADMITTANCE OF ELECTROCHEMICAL PROCESSES. III. THE FREQUENCY DEPENDENCE. Report No. 58. Henry H. Bauer and Philip J. Elving. June 20, 1960. 17p. Project 8. Contract AT(11-1)-70. OTS.

A critical analysis of previously proposed equations for describing the frequency dependence of faradaic admittance of electrochemical processes is presented. The equations, which describe the phase angle between the faradaic alternating current and the alternating potential for simple redox processes, were found adequate only at low frequencies. (C.J.G.)

25454 TID-6514

Oregon. Univ., Eugene.
PHOTO GALVANIC AND PHOTOVOLTAIC EFFECTS WITH ANODIZED ZIRCONIUM AND NIOBIUM ELECTRODES. Wendell M. Graven, Robert E. Salomon, and George B. Adams, Jr. Aug. 1960. 45p. Contract AT(45-1)-535. OTS.

The nature of these photoeffects is examined by the use of data procured with anodized zirconium and niobium electrodes, which function as photogalvanic or photovoltaic cells and exhibit characteristic maximum photopotentials and short-circuit photocurrents. The spectral dependences of photopotentials and photocurrents correspond to the absorption spectra of the isolated anodic oxide films. A model electrode based on the semiconductor properties of the oxide film is proposed to explain the observed photoeffects. (W.L.H.)

25455 TID-6515

Michigan. Univ., Ann Arbor.
HEAT CAPACITIES AND CHEMICAL THERMODYNAMICS OF CERIUM(III) FLUORIDE AND OF CERIUM(IV) OXIDE FROM 5 TO 300°K. Edgar F. Westrum, Jr., and Alvin F. Beale, Jr. [1959?]. 11p. [Project No. 5. Contract AT(11-1)-70]. OTS.

The heat capacities of CeF_3 and CeO_2 were determined from 5 to 300°K by adiabatic calorimetry. Both substances reveal normal sigmoid-shaped thermal behavior over this

range. The entropy (S^0), enthalpy increment ($H^0-H_0^0$), and free energy function ($[F^0-H_0^0]/T$) at 298.15°K are 27.54 cal/(deg mole), 4237 cal/mole, and -13.33 cal/(deg mole) for CeF_3 and 14.89 cal/(deg mole), 2478 cal/mole, and -6.58 cal/(deg mole) for CeO_2 , respectively. (auth)

25456 TID-6571

Oak Ridge Gaseous Diffusion Plant, Tenn.
COMPOUND FORMATION BETWEEN URANIUM AND YTTRIUM OXIDES. N. C. Orrick and Karl E. Rapp. Apr. 1, 1959. 5p. (KL-416). OTS.

Attempts to reduce uranium oxides that had been calcined at temperatures from 350 to 1800°C in the presence of 10 to 22% yttrium oxides failed to achieve complete conversion of the U^{+6} to U^{+4} . Calculations based upon the thermogravimetric observations made during reduction of the samples in hydrogen at 525°C followed by air oxidation at 525°C suggest that a stable compound is formed between the yttrium oxide and uranium oxide corresponding to the formula $\text{Y}_6\text{U}_3\text{O}_{17}$. Once formed, this compound is not affected by exposure either to hydrogen or oxygen at elevated temperatures. (auth)

25457 UCRL-9187

California. Univ., Berkeley. Lawrence Radiation Lab.
ANALYSIS OF CURRENT DISTRIBUTION IN ELECTROLYTIC CELLS WITH FLOWING MERCURY CATHODES (thesis). Edward Anthony Grens, II. July 19, 1960. 78p. Contract W-7405-eng-48. OTS.

An idealized model is postulated embodying the essential features of industrial caustic-chlorine cells with horizontal flowing-mercury cathodes. This model is examined in detail, and relations expressing the local anode potential, cathode potential, and ohmic potential drop in the electrolyte in terms of local current density and other parameters are established. These relations are combined to give a system of equations relating current density at any location along the cell to applied total potential and to operating conditions in the cell upstream of the point in question. Numerical solutions of these equations for several cases of cell operating conditions are carried out on a digital computing machine. The effects of changes in operating parameters upon average current density, individual electrode potentials, and current distribution are evaluated. (auth)

25458 UCRL-9265

California. Univ., Berkeley. Lawrence Radiation Lab.
RATE OF ELIMINATION OF WATER MOLECULES FROM THE FIRST COORDINATION SPHERE OF PARAMAGNETIC CATIONS AS DETERMINED BY NUCLEAR MAGNETIC RESONANCE MEASUREMENTS OF O^{17} (thesis). Eleanor Diane Stover. July 8, 1960. 33p. Contract W-7405-eng-48. OTS.

The O^{17} nuclear magnetic resonance spectra of solutions with various concentrations of paramagnetic ions were studied. Values for the transverse relaxation time, T_2 , were calculated from the line-width broadening. Chromic ion is much less effective than the other cations in shortening T_2 , which is consistent with the theory that relaxation occurs in the first coordination sphere of all the cations studied except in chromic ion. Lower limits for the rates of exchange of bulk water molecules with those in the first coordination sphere of the cations are calculated. The order of decreasing first-order rate constants is $\text{Mn}^{++} > \text{Cu}^{++} > \text{Co}^{++} > \text{Ni}^{++} > \text{Fe}^{+++}$. Saturation experiments on various solutions of paramagnetic ions indicate that T_1 increases with increasing concentration of paramagnetic cation in some cases. A study of the effect of pH on T_2 values shows that within experimental accuracy there

exists no dependence on pH over the range 0.9 to 10.5. (auth.)

25459 UCRL-9293

California, Univ., Berkeley. Lawrence Radiation Lab. THE ELECTRONIC STRUCTURE OF OCTAHEDRALLY COORDINATED PROTACTINIUM(IV) (thesis). John D. Axe. July 1960. 68p. Contract W-7405-eng-48. OTS.

The compound Cs_2ZrCl_6 was used as a matrix for the study of certain magnetic and optical properties of Pa^{4+} . The procedures for the growth of Cs_2ZrCl_6 crystals and the incorporation of small amounts of other tetravalent ions into its structure are discussed. The optical spectrum of Pa^{4+} in this matrix was investigated from 2000 Å to 16 μ . Several features of the spectrum, as well as the results of paramagnetic-resonance absorption in these crystals, are attributed to single 5f electrons localized about the protactinium ions but subject to an octahedrally symmetric perturbation due to the crystal lattice. (auth)

25460 USNRDL-TR-444

Naval Radiological Defense Lab., San Francisco. THE DETERMINATION OF THE OXIDATION STATES OF URANIUM, NEPTUNIUM AND PLUTONIUM IN AQUEOUS MEDIA. S. C. Foti and E. C. Freiling. July 8, 1960. 20p.

The development, testing, and application of a chemical procedure for determining the distributions of uranium, neptunium, and plutonium among their respective oxidation states in various aqueous media at tracer concentrations are described. The media studied were distilled water, salt water, and seawater. The separations are about 95% clean. Recommendations for future investigations are given. (auth)

25461 AEC-tr-4233

SOLUBILITY OF METAL OXIDES IN MOLTEN SALTS.

N. K. Voskresenskaya and G. N. Kashcheev. Translated by C. B. Finch (Oak Ridge National Lab.) from *Izvest. Sektora Fiz-Khim. Anal., Inst. Obshchei Neorg. Khim., Akad. Nauk S.S.S.R.* 27, 255-67 (1956). 27p. (Includes original, 13p.). JCL or LC.

Data on the solubility of MgO , CaO , ZnO , Cr_2O_3 , and CuO in the chlorides and sulfates of Li, Na, and K at 700 to 1000°C are given. Literature data on these oxides are also included. (J.R.D.)

25462 AEC-tr-4234

THEORY ON THE STATES OF MATTER. P. P. von Weilmarn. Translated from *Z. Chem. u. Ind. Kolloide* 2, 275-84 (1907-8). 24p. JCL.

Reactions between $\text{Ba}(\text{CNS})_2$ with MnSO_4 in which a large-celled gel is formed which gradually transforms into a very fine white precipitate of BaSO_4 were investigated. Results indicate that BaSO_4 can be transformed gradually from a distinctly crystalline state into the state of typical gels by a variation of the concentration of reacting solutions. Other observations on crystals and colloids are included. (J.R.D.)

25463 AEC-tr-4235

THEORY ON THE STATES OF MATTER. P. P. von Weilmarn. Translated for Oak Ridge National Lab. from *Z. Chem. u. Ind. Kolloide* 2, 301-7 (1907-08). 18p. JCL.

A general method for production of crystals from gel-like compounds is described. This information is of value in analytical-chemistry operations in which filtering and washing of precipitates are required. Recrystallization in $\text{Al}(\text{OH})_3$ and BaSO_4 gels and sols is investigated and other examples are discussed. (J.R.D.)

25464 AEC-tr-4236

THEORY ON THE STATES OF MATTER. P. P. von

Weilmarn. Translated for Oak Ridge National Lab. from *Z. Chem. u. Ind. Kolloide* 2, 326-35 (1907-08). 22p. JCL.

The effects of solubility of a compound, under specified conditions, on the form in which it precipitates were investigated. The investigations were conducted to show that any arbitrary material can be transformed into amorphous and crystalline states by variation of controlling factors and to find the fundamental basis of the two states. (J.R.D.)

25465 CEA-tr-R-843

MESURES DE LA PRESSION DE VAPEUR SATURÉE DU CHLORURE DE LANTHANE ANHYDRE PAR LA MÉTHODE DES TRACEURS. (Measurement of the Saturated Vapor Pressure of Anhydrous Lanthanum Chloride by a Tracer Technique). A. N. Nesmeyanov (Nesmeianov) and L. A. Sazonov. Translated into French from *Zhur. Neorg. Khim.* 4, 230-1 (1959). 7p.

The vapor pressure of LaCl_3 was measured by the Knudsen method using tracers. The chromatographically purified La^{140} was converted to chloride, degassed, and condensed onto a liquid-nitrogen-cooled surface, and the α activity was measured. The vapor-pressure equation obtained was $\log P(\text{mm Hg}) = -15284/T + 11,9163$. (T.R.H.)

25466

RECENT INVESTIGATIONS ON METALLIC SULFIDES. J. Flahaut (Faculté de Pharmacie, Paris). *Bull. soc. chim. France* No. 7, 1282-90 (1960) July. (In French)

A survey is given of the studies made in the last ten years on metallic sulfides. The nomenclature of the sulfides is first discussed. Three methods of preparation are then briefly considered: direct union of the two elements, thermal dissociation of higher sulfides, and reduction of oxysulfides with carbon or aluminum. The crystal structure and properties of the metallic sulfides are then reviewed. 53 references. (J.S.R.)

25467

THE BINARY MIXTURE H_2/HD . H. U. Karwat (Technische Hochschule, Munich). *Chem.-Ingr.-Tech.* 32, 605-10 (1960) Sept. (In German)

The deviation of the binary mixture H_2/HD from the ideal distillation behavior at 20°K was examined. The range of low HD concentrations was specially considered. Vapor-pressure differences between H_2/HD mixtures and pure hydrogen were measured. The activity coefficients derived from these measurements are approximately one. (auth)

25468

PREPARATION OF ANHYDROUS ZIRCONIUM TETRAFLUORIDE FROM THE CARBIDE AND NITRIDE OF ZIRCONIUM. Jean Niemiec (Université Libre, Brussels). *Compt. rend.* 251, 875-7 (1960) Aug. 8. (In French)

The preparation of anhydrous zirconium tetrafluoride was studied using ammonium fluoride acid as fluoridation agent and with the carbide, nitride, or carbonitride as initial product. The results show that the fluorination has a good yield and that, after sublimation under vacuum, it is possible to obtain a very pure zirconium tetrafluoride. (tr-auth)

25469

EFFECT OF ACIDIC ACTIVATION AND ELECTRODIALYSIS ON THE LYOPHILIA OF MONTMORILLONITE. F. D. Ovcharenko and I. I. Martyn (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). *Dopovidi Akad. Nauk Ukr. R.S.R.* No. 6, 809-12 (1960). (In Ukrainian)

Treatment of montmorillonite with 25% sulfuric acid led to a change in its lyophilic properties, decreasing the size of the specific surface, the heat of wetting, and the quantity of bound water by 21%. After electrodialysis of an activated specimen specific surface, heat of wetting, and quantity of

bound water are increased. This is due to the appearance of colloid-dispersed SiO_2 in the system. The sorption isotherms and the static activity confirm this conclusion. Treatment of montmorillonite with acid led to a fall in its exchange capacity, especially after electrodialysis, to almost one-third (from 94.4 to 38.3 mg eq. per 100 grams of clay). (auth)

25470

ION TRANSPORT IN SODIUM-AMMONIA SOLUTIONS. J. L. Dye, R. F. Sankuer, and G. E. Smith (Michigan State Univ., East Lansing). *J. Am. Chem. Soc.* **82**, 4797-4803 (1960) Sept. 20.

The anion transference number was measured as a function of concentration for sodium-ammonia solutions at -37° by the moving-boundary method. The apparatus is described. The ionic equivalent conductance of Na^+ was calculated from these data and existing conductivity data. Assuming that the conductance of free sodium ions follows the Shedlovsky equation, the degree of dissociation of ion-pairs (or monomers) and the concentration of dimers were calculated. A satisfactory fit of the data was obtained using two equilibrium constants; $K_1 = 9.2 \times 10^{-3}$ for the dissociation reaction, and $K_2 = 18.5$ for the dimerization reaction. (auth)

25471

THE ACTIVITY COEFFICIENT OF SODIUM IN LIQUID AMMONIA. J. L. Dye, G. E. Smith, and R. F. Sankuer (Michigan State Univ., East Lansing). *J. Am. Chem. Soc.* **82**, 4803-7 (1960) Sept. 20.

Transference number data from moving-boundary measurements and data from the emf of cells with transference were used to calculate the activity of sodium in liquid ammonia as a function of concentration. Consideration of ion-pairing and dimerization equilibria allowed extrapolation of the data to infinite dilution and resulted in values of 9.6×10^{-3} and 23, respectively, for the equilibrium constants of the reactions: (1) $\text{Na}^+ \cdot e^- \rightleftharpoons \text{Na}^+ + e^-$ and (2) $2\text{Na}^+ \cdot e^- \rightleftharpoons \text{Na}_2$. The results were combined with published vapor pressure data for the high concentration region and with calorimetric data to give a partial molar entropy of 16.9 ± 1.8 cal deg^{-1} mole^{-1} for the solvated electron in the hypothetical ideal one molal solution. (auth)

25472

THE PREPARATION OF $(\text{Nb}_6\text{Cl}_{12})\text{Cl}_2 \cdot 7\text{H}_2\text{O}$. Herbert S. Harned, Crellin Pauling, and Robert B. Corey (California Inst. of Tech., Pasadena). *J. Am. Chem. Soc.* **82**, 4815-17 (1960) Sept. 20.

$\text{Nb}_6\text{Cl}_{14} \cdot 7\text{H}_2\text{O}$ was first prepared in 1913 by reduction of NbCl_5 with sodium amalgam, but the yield was not high and some recent attempts to use the method for large-scale preparations were disappointing. An investigation was made of the use of other metals as reducing agents, of which cadmium was found to be the most satisfactory. Essential details of a new procedure for preparing $\text{Nb}_6\text{Cl}_{14} \cdot 7\text{H}_2\text{O}$ from metallic niobium are given. (auth)

25473

THE SOLUBILITY OF URANIUM(IV) FLUORIDE IN AQUEOUS FLUORIDE SOLUTIONS. Albert W. Savage, Jr. and James C. Browne (Los Alamos Scientific Lab., N. Mex.). *J. Am. Chem. Soc.* **82**, 4817-21 (1960) Sept. 20.

The solubility of $2\text{UF}_4 \cdot 5\text{H}_2\text{O}$ was measured at 25.0° as a function of fluoride ion concentration in mixtures of hydrofluoric and perchloric acids at a constant ionic strength of 0.12 M. Uranium was determined by radioassay using U^{233} as a tracer. Equilibrium was established by approaching from both sides. The behavior of the equilibrium solubility, which varied from 1.35×10^{-3} M at $[\text{F}^-] = 1.9 \times 10^{-5}$ M,

through a minimum of 0.12×10^{-3} M at $[\text{F}^-] = 9.6 \times 10^{-4}$ M to 0.37×10^{-3} M at $[\text{F}^-] = 1.5 \times 10^{-2}$ M, is best explained by the existence in solution of the species UF_2^{2+} , UF_3^+ , UF_4 , UF_5^- , and UF_6^{2-} . (auth)

25474

CHARGE TRANSFER REACTIONS PRODUCING INTRINSIC CHEMICAL CHANGE: METHYL, METHYLENE, AND HYDROGEN RADICALS PRODUCED FROM ARGON AND METHANE REACTIONS. C. E. Melton (Oak Ridge National Lab., Tenn.). *J. Chem. Phys.* **33**, 647-51 (1960) Sept.

Charge transfer reactions producing intrinsic chemical changes in the neutral molecule were proven by mass spectrometric techniques. The charge transfer reaction $\text{Ar}^+ + \text{CH}_4 \rightarrow \text{Ar} + \text{CH}_3^+ + \text{H}$, which produces an intrinsic chemical change in CH_4 , was found to be more probable by a factor of five than the simple charge transfer reaction $\text{Ar}^+ + \text{CH}_4 \rightarrow \text{Ar} + \text{CH}_4^+$. Charge transfer reactions in mixtures of Ar and CH_4 and Kr and CH_4 were studied at 0.1 to 0.5 mm Hg in the ionization chamber. Reactions were elucidated by catalytic and negative ion studies and the usual pressure and appearance potential techniques. In the Kr + CH_4 mixture, the reaction $\text{Kr}^+ + \text{CH}_4 \rightarrow \text{Kr} + \text{CH}_3^+ + \text{H}$, which produces the charged radical CH_3^+ , was found to have a high probability. Absolute values for rate constants and cross sections are given for all the charge transfer reactions observed in the Ar + CH_4 mixture. Products from these elementary charge transfer reactions are correlated to previously reported radiolytic, α ionization (W value), and hydride ion transfer studies. (auth)

25475

FORCE CONSTANTS FOR NH_4^+ AND ND_4^+ . S. Sundaram (Univ. of Chicago). *J. Chem. Phys.* **33**, 708-9 (1960) Sept.

Normal coordinate analysis for XY_4 -type molecules of T_d symmetry was carried out by the Wilson FG-matrix method. By the use of the spectral data that were established by Dennison on NH_4^+ and ND_4^+ , the anharmonicity factors were calculated. The constants of the most general quadratic potential-energy function were obtained for the ammonium ion. (auth)

25476

NUCLEAR MAGNETIC RESONANCE SPECTRA OF SYSTEMS OF THE $\text{A}_3\text{B}_2\text{C}$ TYPE: PROTON MAGNETIC RESONANCE SPECTRA AND THE ABSOLUTE SIGNS OF THE PROTON-PROTON SPIN COUPLING CONSTANTS IN ETHYL ACETYLENE AND ETHYL MERCAPTAN. P. T. Narasimhan and Max T. Rogers (Michigan State Univ., East Lansing). *J. Chem. Phys.* **33**, 727-33 (1960) Sept.

The high-resolution proton magnetic resonance spectra of ethyl acetylene and ethyl mercaptan were studied at 40 Mc and 60 Mc. Theoretical analysis of these spectra as systems of the $\text{A}_3\text{B}_2\text{C}$ type enables the relative signs of the proton-proton spin coupling constants in these molecules to be determined. It is shown that the spin coupling constants $J_{\text{CH}_3-\text{CH}_2}$ and $J_{\text{CH}_2-\text{CH}}$ are of opposite sign in ethyl acetylene, whereas $J_{\text{CH}_3-\text{CH}_2}$ and $J_{\text{CH}_2-\text{SH}}$ in ethyl mercaptan are of the same sign. By the use of the results of the valence bond theory regarding the absolute sign of $J_{\text{CH}_3-\text{CH}_2}$, the present analysis has made possible determinations of the absolute sign of $J_{\text{CH}_2-\text{CH}}$ and $J_{\text{CH}_2-\text{SH}}$ in ethyl acetylene and ethyl mercaptan, respectively. (auth)

25477

THRESHOLD LAW FOR THE PROBABILITY OF EXCITATION OF MOLECULES BY PHOTON IMPACT. A STUDY OF THE PHOTOIONIZATION EFFICIENCIES OF Br_2 , I_2 , HI , AND CH_3I . J. D. Morrison (Univ. of Chicago),

H. Hurzeler, Mark G. Inghram, and H. E. Stanton.

J. Chem. Phys. **33**, 821-4(1960) Sept.

A study is made of two types of excitation process in molecules, leading to either dissociation to an ion-pair or to autoionization. The latter process, in the case of the iodine-containing molecules, clearly makes a very significant contribution to the total ionization. The threshold law for the probability of excitation by photon impact is shown to be approximated closely by a delta function of the excess energy. Energy values are measured for various states of the molecules and are in good agreement with available spectroscopic data. The electron affinities of bromine and iodine are found to be 3.53 ± 0.12 and 3.13 ± 0.12 eV, respectively. (auth)

25478

MASS SPECTRA OF ALUMINUM(III) HALIDES AND THE HEATS OF DISSOCIATION OF $\text{Al}_2\text{F}_6(\text{g})$ AND $\text{LiF} \cdot \text{AlF}_3(\text{g})$.

Richard F. Porter and Ernest E. Zeller (Cornell Univ., Ithaca, N. Y.). *J. Chem. Phys.* **33**, 858-63(1960) Sept.

Mass spectra of gaseous aluminum(III) chloride and bromide were obtained and interpreted quantitatively in terms of the degree of association in the vapor phase. Ion currents indicative of a molecular trimer of AlCl_3 were observed. Mass spectra of the vapors effusing from a Knudsen cell containing AlF_3 were obtained and the stability of the molecular dimer of $\text{AlF}_3(\text{g})$ was determined quantitatively. Mass spectra of vapors from $\text{LiF} \cdot \text{AlF}_3$ mixtures indicate the existence of a stable $\text{LiF} \cdot \text{AlF}_3(\text{g})$ molecule. Ion current data were obtained as a function of condensed phase composition. A second complex molecular species which appears to be either $(\text{LiF})_2 \cdot \text{AlF}_3(\text{g})$ or $(\text{LiF} \cdot \text{AlF}_3)_2(\text{g})$ was observed. For the reaction $\text{Al}_2\text{F}_6(\text{g}) = 2\text{AlF}_3(\text{g})$, $\Delta H^\circ_{1000} = 48.0 \pm 4.0$ kcal/mole dimer, and for $\text{LiF} \cdot \text{AlF}_3(\text{g}) = \text{LiF}(\text{g}) + \text{AlF}_3(\text{g})$, $\Delta H^\circ_{1000} = 73 \pm 4$ kcal/mole. (auth)

25479

INTERATOMIC DISTANCES IN FeS_2 , CoS_2 , AND NiS_2 .

Norman Elliott (Brookhaven National Lab., Upton, N. Y.). *J. Chem. Phys.* **33**, 903-5(1960) Sept.

The crystal structures of FeS_2 , CoS_2 , and NiS_2 were re-examined. The sulfur-sulfur distances are found to vary, depending on the number of antibonding electrons shared with the metal ions. (auth)

25480

ABSORPTION SPECTRA OF ANODIC NIOBIUM OXIDE FILMS. W. M. Graven, R. E. Salomon, and G. B. Adams, Jr. (Univ. of Oregon, Eugene).

J. Chem. Phys. **33**, 954-5(1960) Sept.

The absorption spectra of anodically formed oxide films on niobium metal were obtained. A sodium phosphate-phosphoric acid solution buffered at pH 9 was used as an electrolyte for anodizing most of the 0.5-mil, 99.7%-pure foils. A sodium borate-boric acid solution at pH 9 produced films that showed equivalent spectra. Absorption spectra of two films obtained with 25-v and 200-v formation voltages are shown. The long wavelength limit of absorption is estimated to be ~ 3500 Å, which is in agreement with previous values. (B.O.G.)

25481

THE HEATS OF FORMATION OF BF_2Cl AND BFCl_2 .

Stuart R. Gunn and Russell H. Sanborn (Univ. of California, Livermore). *J. Chem. Phys.* **33**, 955-6(1960) Sept.

Higgins et al. reported a value of 0.53 ± 0.04 for the equilibrium constant at 27 to 29°C of the reaction: $\text{BF}_3 \times \text{BCl}_3 \rightarrow \text{BF}_2\text{Cl} + \text{BFCl}_2$. By the use of fundamental frequencies given by Lindeman and Wilson, a B-F distance of 1.295 Å, a B-Cl distance of 1.73 Å, and with the as-

sumption that bond distances and angles in the mixed species are unchanged from those in the pure species, the standard entropies were calculated at 25°C for each of the reactants and resultant compounds. From the equilibrium constant, the standard free-energy change of the reaction is calculated to be $+0.38$ kcal/mole⁻¹; and the heat of reaction is calculated to be $+1.68$ kcal/mole⁻¹. Three possible equilibrium mixtures formed from 0.5 mole each of BF_3 and BCl_3 are listed, for which the free-energies and heats of formation are calculated. A spectrographic determination of the heat of reaction is illustrated. Application of the van't Hoff equation yields a heat of reaction in agreement with the spectrographic calculation. (B.O.G.)

25482

THE FAILURE OF DISPERSION ENERGY CALCULATIONS TO REPRODUCE HEATS OF ADSORPTION ON GRAPHITIC CARBON.

Donald Graham (E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.). *J. Phys. Chem.* **64**, 1089-92(1960) Sept.

Isothermic heats of adsorption of nitrogen on diamond, amorphous carbon, and thermally graphitized P^{33} differed very little at the coverage approaching completion of the first monolayer. The effect of the much greater density of diamond was thus balanced by a correspondingly greater contribution (per atom) from the electrons of the graphitic carbons. Calculated dispersion energies failed to reproduce this result, indicating the possible importance of other forms of electronic interaction. (auth)

25483

HYDROGEN SORPTION ON GRAPHITE AT ELEVATED TEMPERATURES.

J. P. Redmond and P. L. Walker, Jr. (Pennsylvania State Univ., University Park). *J. Phys. Chem.* **64**, 1093-9(1960) Sept.

The sorption of hydrogen on selected types of nuclear and spectroscopic graphite was studied. On nuclear graphite, the desorption of hydrogen over the temperature range 1035 to 1375° followed the Elovich equation. The activation energy of desorption over the coverage range (θ) , 0.32 to 0.68 could be approximated as $E' = 137 - 42(\theta)$ kcal/mole. On the basis of limited results, it was found that the adsorption of hydrogen at 1335° on nuclear graphite could also be expressed by the Elovich equation. Isotherms for sorption of hydrogen on both nuclear and spectroscopic graphites over the temperature range 920 to 1495° were of the Temkin type. However, at temperatures of 1085° and above, the isotherms consisted of two straight-line regions of markedly different slopes. From the isotherms at 1335 and 1495° for the nuclear graphite, the heat of adsorption over the coverage range, 0.50 to 0.80, could be approximated as $Q = 58 - 56(\theta)$ kcal/mole. It was concluded that the adsorption of hydrogen occurred on carbon atoms at the edge of crystallites and that significant intracrystalline sorption did not occur. (auth)

25484

DETECTION OF METAL ION HYDROLYSIS BY COAGULATION. II. THORIUM. E. Matijević, M. B. Abramson,

K. F. Schulz, and M. Kerker (Clarkson Coll. of Tech., Potsdam, N. Y.). *J. Phys. Chem.* **64**, 1157-61(1960) Sept.

Coagulation and stabilization concentrations for aqueous thorium nitrate solutions were obtained as a function of pH using silver iodide, silver bromide, and silver chloride sols *in statu nascendi*. At pH < 4, the coagulation concentration showed a constant value corresponding to a four-valent species, Th^{4+} or $\text{Th}(\text{H}_2\text{O})_x^{4+}$. With increasing pH the coagulation concentration increased and leveled off at a value characteristic for trivalent counterions. It is believed, therefore, that the initial hydrolysis step of Th^{4+} consisted

in formation of $[\text{Th}(\text{H}_2\text{O})_{x-1}\text{OH}]^{3+}$ species. At still higher pH's the coagulation concentrations again became much lower indicating high valent species, possibly a dimer $[\text{Th}(\text{H}_2\text{O})_{x-1}\text{OH}]_2^{4+}$. Reversal of charge was produced by the hydrolyzed thorium species, whereas the four-valent thorium ion did not reverse the charge. The problem of reversal of charge was discussed, and it was concluded that this effect was caused by OH-bridging of counterions. (auth)

25485

SOLUTIONS OF METALS IN MOLTEN SALTS CERIUM IN CERIUM TRICHLORIDE. H. R. Bronstein, A. S. Dworkin, and M. A. Bredig (Oak Ridge National Lab., Tenn.). *J. Phys. Chem.* **64**, 1344(1960) Sept.

An investigation of the Ce-CeCl₃ system indicated that data obtained in emf and conductivity measurements in sintered alumina crucibles did not pertain to the Ce-CeCl₃ system. Rather the cerium was converted to CeOCl. The inner wall of the crucible showed severe attack and its weight was reduced. (M.C.G.)

25486

DETERMINATION OF DIFFUSION COEFFICIENTS BY A METHOD BASED ON THE DISPLACEMENT OF THE ACTIVITY CURVE. M. B. Bronfin, S. Z. Bokshtein, and A. A. Zhukhovitskiĭ. *Zavodskaya Lab.* **26**, 828-30(1960). (In Russian)

Determination of the diffusion coefficients in the solid state by radioisotopes that emit β or soft γ radiation is complicated by the fact that the absorption characteristics of the material under study must also be investigated. The need for involving the absorption was avoided by a method that consists in removal of layers and the determination of the total activity of the remainder of the sample, calculating the coefficient from the shift of the activity curve. By means of this method the self-diffusion coefficient of molybdenum was determined in the temperature range of 1700 to 1920°C, using a Mo⁹⁹ layer deposited on the molybdenum bar. The coefficient is defined by the equation: $D = 2.77 \cdot e - 111000/RT \text{ cm}^2 \text{ sec}^{-1}$. The layers were removed mechanically and by electropolishing. The method is also adaptable for work with hard γ radiation. The least square error of the method was found to be 10 to 15%. (TTT)

25487

HEAT OF FORMATION OF POTASSIUM COMPOUNDS. P. G. Maslov (Leningrad Military Mechanical Inst.). *Zhur. Neorg. Khim.* **5**, 1669-75(1960) Aug. (In Russian)

Approximation formulas are developed for heats of formation and in some cases for other thermal characteristics of a large group of potassium compounds in solid and partially dissolved states at 25°C. The order of accuracy of the formulas is about 0.2 to 1%. The heats of formation are tabulated for a large number of compounds and many complex crystal line hydrates, including the $2 \text{ KCl} \cdot \text{UO}_2\text{Cl}_2 \cdot n\text{H}_2\text{O}$ and $m\text{KCl} \cdot \text{ThCl}_4 \cdot n\text{H}_2\text{O}$. (R.V.J.)

25488

ANION INFLUENCE ON URANYL ION REDUCTION ON A DROP MERCURY ELECTRODE. A. I. Alekperov and S. I. Zhdanov. *Zhur. Neorg. Khim.* **5**, 1743-7(1960) Aug. (In Russian)

Polarograms of uranyl ions in weak and medium acid solutions contain two waves corresponding to $\text{UO}_2^{2+} + e \rightleftharpoons \text{UO}_2^+$ and $\text{UO}_2^+ + 2e + 4\text{H}^+ \rightarrow \text{U}^{3+} + 2\text{H}_2\text{O}$ processes. The UO_2^+ ions are unstable in the presence of hydrogen ions and dissociate into hexavalent and tetravalent uranium: $2\text{UO}_2^+ + 4\text{H}^+ \rightarrow \text{UO}_2^{2+} + \text{U}^{4+} + 2\text{H}_2\text{O}$. Studies were made of the influence of hydrochloric, nitric, sulfuric, oxalic, and hydrofluoric acids on the uranyl ions. Chloride and nitrate ions

do not affect the UO_2^{2+} while the rest of the anions shift the wave toward a negative potential in weak acid solutions and induce a strong wave build-up in strong acid solutions. The formation of uranyl ion complexes with anions shifts the wave and increases the current, implying a speed up in UO_2^+ ion disproportionation. The anions bind the U^{4+} ions in stable complexes, thus speeding up the disproportionation according to the formula: $2\text{UO}_2^+ + 4\text{H}^+ \rightarrow \text{UO}_2^{2+} + \text{U}^{4+} + 2\text{H}_2\text{O}$. (R.V.J.)

25489

ON THE NEW BORIDE PHASE IN BERYLLIUM-BORON SYSTEMS. G. S. Markevich, Yu. D. Kondrashev, and L. Ya. Markovskii (State Inst. of Applied Chemistry, USSR). *Zhur. Neorg. Khim.* **5**, 1783-7(1960) Aug. (In Russian)

Be_5B has a tetragonal structure with cell parameters $a = 3.362 \pm 0.002$, $c = 7.036 \pm 0.005 \text{ kX}$. The physical and chemical properties of beryllium boride were studied. Subacid compounds corresponding to BO form in Be_5B hydrolysis. A formula is developed for boride hydrolysis. The borohydrogen yield in Be_5B decomposition by hydrochloric acid is about 8% of the total boron. (R.V.J.)

25490

ACTIVITIES OF ERBIUM AND YTTERBIUM OXIDES. N. V. Aksel'rud (Baikov Inst. of Metallurgy, Academy of Sciences, USSR). *Zhur. Neorg. Khim.* **5**, 1910-11(1960) Aug. (In Russian)

The results of studies carried out with erbium and ytterbium chlorides 290 and 275 days after their preparation are tabulated. The basic chloride content is $\text{Er}(\text{OH})_{2.5}\text{Cl}_{0.5}$ with the activity products 7.62×10^{-23} ($\Delta Z_{290}^0 = -298.64 \text{ kcal/mole}$) at $\lg a_{\text{Cl}^-} = +0.30$, and with $\lg a_{\text{Cl}^-} = 0.00$ to -1.00 and hydroxide with $\Pi a = 2.69 \times 10^{-27}$ ($\Delta Z_{290}^0 = -307.86 \text{ kcal/mole}$). Hydroxide with $\Pi a = 2.29 \times 10^{-27}$ ($\Delta Z_{290}^0 = -305.89 \text{ kcal/mole}$) forms in the ytterbium system in the range of $\lg a_{\text{Cl}^-} = (+0.30 \text{ to } -1.0)$ after 275 days. Equilibrium ion activity in heterogeneous systems $\text{Er}^{3+} - \text{OH}^- - \text{Cl} - \text{H}_2\text{O}$ and $\text{Yb}^{3+} - \text{OH}^- - \text{Cl} - \text{H}_2\text{O}$ is found after 290 and 275 days at 25°C. (R.V.J.)

25491

INVESTIGATION OF THE KINETICS OF THE INTERACTION OF THE HIGHER OXIDES OF TANTALUM, NIOBIUM, TITANIUM, AND ZIRCONIUM WITH PHOSPHORUS PENTACHLORIDE. L. A. Nisel'son and T. D. Sokolova. *Zhur. Priklad. Khim.* **33**, 1755-61(1960) Aug. (In Russian)

In view of the interest of the reaction products for separating and purifying the elements, the chlorination reaction of rare element oxides with PCl_5 was studied paying special attention to the effect of the physical nature of the oxide, such as the preliminary heat treatment and specific surface on the kinetics of the reaction. It was found that the temperature range studied (from 150 to 300°C) lies within the kinetic region. The activation energy of chlorination of the oxides was determined from the slope of the Arrhenius plot. The chlorination velocity was found to depend strongly on the method of preparation of the oxides, especially on the preliminary heat treatment as calcination at various temperatures results in a change of the specific surface. The data can be applied to chlorination reactions by means of other reagents, including elementary chlorine. (TTT)

25492

IMPROVEMENTS IN OR RELATING TO PRODUCTION OF CHLORIDES OF METALS. Allan Robert Gibson, John Harold Buddery, and Keith Thornbury Harrison (to United Kingdom Atomic Energy Authority). British Patent 843,261. Aug. 4, 1960.

Metal chlorides which are deliquescent or readily hydrolyzed (e.g., those of thorium, beryllium, and uranium) can

be produced by chlorination of the oxides other than titanium-containing oxides in the following way: The oxide to be chlorinated is added to a melt comprising an alkali metal chloride and/or alkaline earth metal chloride (Cl_2 and C or CO). Excess of Cl_2 and CO are desirable. When the metal whose chloride is to be formed has only one stable valence, the reaction is assisted by the chloride of a metal having more than one stable valence (e.g., Fe). Four applications of the above method are given for production of ThCl_4 and UCl_3 . (D.L.C.)

25493

ELECTROLYTIC CELLS FOR RECLAIMING URANIUM FROM SOLUTIONS. (to United Kingdom Atomic Energy Authority). British Patent 843,482. Aug. 4, 1960.

An electrolytic cell is designed for reducing UO_2^{2+} and Fe^{3+} to U^{4+} and Fe^{2+} in wash solutions derived from calutrons employed in producing uranium enriched with U^{235} . The cell contains alternating anode and cathode compartments separated by porous partitions, and means are arranged for continuous feed of the solution to be reduced into the cell. (D.L.C.)

25494

PURIFICATION OF ZIRCONIUM TETRA HALIDES. (to National Distillers and Chemical Corp.). British Patent 847,047. Sept. 7, 1960.

Zirconium tetrahalides can be purified by distillation from a NaCl and/or KCl melt at 340 to 450°C, but a difficulty ensues which hinders use of this method on a commercial scale: after a short period of distillation, the distilled product begins to take on a faint yellow color, indicating that some impurities, particularly FeCl_3 , are distilling over. This difficulty can be remedied by adding a minor amount (0.5 to 5 wt. %) of finely divided Fe, Zr, Zr dihalide, Zr trihalide, or Zr halide-alkali metal halide complex, which suppresses the volatility of undesirable metal halide impurities. Thus the distillation can be carried out continuously. Four examples of this method are given for ZrCl_4 purification. (D.L.C.)

25495

PROCESS OF OXIDIZING PLUTONIUM. (to United Kingdom Atomic Energy Authority). British Patent 847,641. Sept. 14, 1960.

Pu^{3+} and Pu^{4+} in solution can be easily oxidized to Pu^{6+} by Ag^{2+} . This method is superior to conventional methods of oxidation, e.g., by Cl_2 , $\text{K}_2\text{Cr}_2\text{O}_7$, or $\text{K}_2\text{S}_2\text{O}_8$, in that the reaction is rapid and carries its own indicator (excess of Ag^{2+} gives a brown color to a colorless solution). The oxidizing solution is prepared by dissolving AgO or silver(II) peroxyhydrate (0.1 M) in a cold solution which is 9 N HNO_3 and 0.4 N AgNO_3 . The procedure for preparation of AgO from AgNO_3 solution is given. An example of oxidation of plutonium in the above manner is given in which oxidation is 98% complete in 1 minute. (D.L.C.)

25496

PRODUCTION OF BERYLLIUM FLUORIDE. Simon J. Morana and Gordon F. Simons (to Beryllium Corp.). British Patent 848,345. Sept. 14, 1960.

The method of production of BeF_2 from the $\text{NH}_4\text{HF}_2 + \text{BeO}$ reaction is modified so that only 1 mole (instead of 2) of NH_4HF_2 is required per mole of BeO, the reaction is speeded up, and a BeF_2 product is obtained which has a lower melting point and is easy to pour at high temperatures. The modified process consists of heating BeO with 100 to 120% of the stoichiometric amount of NH_4HF_2 in the presence of an amount of H_2O one-third of the BeO weight to promote BeF_2 formation and then heating the reaction product at >600°C in the presence of NaCl or MgF_2 . The

final BeF_2 product, prepared in this way in 5 hr, can be easily poured at 800 to 850°C and, at room temperature, is a hard friable material of spongelike appearance and of very low density compared with the product from the unmodified process. It contains NaCl or MgF_2 , but that does not matter if the product is to be used to produce beryllium. (D.L.C.)

25497

METHOD OF DISSOLVING MASSIVE PLUTONIUM. J. F. Facer and W. L. Lyon (to U. S. Atomic Energy Commission). U. S. Patent 2,942,938. June 28, 1960.

Massive plutonium can be dissolved in a hot mixture of concentrated nitric acid and a small quantity of hydrofluoric acid. A preliminary oxidation with water under superatmospheric pressure at 140 to 150°C is advantageous.

25498

PROCESS OF PREPARING ZIRCONIUM OXYCHLORIDE. H. A. Wilhelm and M. L. Andrews (to U. S. Atomic Energy Commission). U. S. Patent 2,942,944. June 28, 1960.

A process is given for preparing zirconyl chloride by mixing solid zirconyl chloride octahydrate and solid zirconium tetrachloride at room temperature whereby both chlorides are converted to zirconyl chloride trihydrate and hydrogen chloride is formed and volatilized by the reaction heat.

25499

COMPLEX FLUORIDES OF PLUTONIUM AND AN ALKALI METAL. G. T. Seaborg (to U. S. Atomic Energy Commission). U. S. Patent 2,947,601. Aug. 2, 1960.

A method is given for precipitating alkali metal plutonium fluorides, such as KPuF_6 , KPu_2F_9 , NaPuF_6 , and RbPuF_6 , from an aqueous plutonium(IV) solution by adding hydrogen fluoride and alkali-metal-fluoride.

Radiation Chemistry and Radiochemistry

25500 ORNL-2983(p.26-31)

Oak Ridge National Lab., Tenn.

RADIATION CHEMISTRY. G. E. Moore, E. H. Taylor, et al.

The effect of displacement of atoms (by fast-neutron bombardment of copper) on reactions catalyzed at the surface and the relationship between catalysis and semiconductivity (using intrinsic and doped germanium) are being investigated by determining the kinetics of the H_2 - D_2 exchange and the catalytic decomposition of formic acid vapor. Tracer and adsorption studies connected the radiation-produced color centers and paramagnetic resonance in silica gel with positive holes and trapped electrons respectively. Their influence on the radiation enhancement of the catalytic activity of the gel is discussed. The pressed alkali halide disc method for the identification and quantitative determination of organic and inorganic solids was used as a tool for study of the effect of variation of structure of the receiver on the transfer of radiation energy primarily absorbed by the alkali halide and the effect of various alkali halides on energy transfer to a given receiver. Studies of sulfuric acid solutions containing Ce(IV) and Fe(II) showed that chemical intermediates arise on irradiation from the sulfuric acid as well as the water. The important intermediates are H, OH, HSO_4 , H_2O_2 , $\text{H}_2\text{S}_2\text{O}_8$, H_2SO_5 , and H_2 ; $\text{H}_2\text{S}_2\text{O}_8$ and H_2SO_5 produced linearly with dose, may build up to appreciable concentrations in solutions containing Ce(IV). Radiolysis of aqueous methane solutions, and also methane solutions with

added ceric sulfate or ferric sulfate, indicated that methane reacts readily with OH but not with H. The OH radical yield in Co^{60} -irradiated aqueous NaNO_3 solutions, 5.0 M and less, was observed to be constant, indicating that energy is transferred from the solute to the solvent and that the OH radical does not react with nitrate ion. The Co^{60} irradiation of concentrated aqueous NaNO_3 solutions indicated that molecular hydrogen is formed by two mechanisms. These are the decomposition of excited water molecules (Samuel-Magee model) and the reaction of diffusing electrons with water molecules (Lea-Gray-Platzman model). Elimination of H_2 resulting from the Samuel-Magee mechanism may be accomplished by a high concentration of a solute that scavenges H atoms or by carrying out the irradiation at -196°C . Experimental evidence was obtained to support the view that the alpha radiolysis of CO proceeds through ionic and excited species and that the active ionic species, CO^+ , is deactivated by charge transfer to the product CO_2 . There is no evident depletion of the excited species. (auth)

25501 ORNL-2993(p.183-6)

Oak Ridge National Lab., Tenn.

RADIATION EFFECTS ON CATALYSTS.

Initial experiments on the effects of radiation on catalysts showed that Co^{60} irradiation to a dose of 1.8×10^{11} ergs/g of a promoted chromia-alumina catalyst increased its effectiveness as a catalyst for the dehydrogenation of methylcyclohexane at 460°C about 30%. The use of S^{35} in $\text{MgSO}_4\text{-Na}_2\text{SO}_4$ catalysts for the dehydration of cyclohexanol doubled the reaction rate at 290°C when 25.9 ml/g of S^{35} was incorporated (as Na_2SO_4) into the catalyst. Irradiation by Co^{60} showed no effect on this catalyst. (auth)

25502 TID-6402

[Massachusetts Inst. of Tech., Cambridge].

THE EFFECT OF IRRADIATION PRIOR TO REACTION ON CATALYST ACTIVITY. Quarterly Progress Report No. 3. Nicholas J. Stevens. July 1960. 7p. Contract AT(30-1)-2329. OTS.

A reduction of ~50% catalytic activity of calcined ZnO was noted in samples that had been irradiated. Thin Cu_2O disks (1000 Å) were prepared by alternate oxidation and reduction steps. (C.J.G.)

25503 TID-6456

Illinois. Univ., Urbana. Noyes Lab. of Chemistry.

DIFFUSION-KINETICS IN RADIATION CHEMISTRY. I. GENERALIZED FORMULATION AND CRITICISM OF DIFFUSION MODEL. Aron Kuppermann and Geneva G. Belford. [1960]. 56p. Contract AT(11-1)-691. OTS.

A general mathematical formulation of the diffusion-kinetic model of chemical effects of high-energy radiations is given in terms of a system of simultaneous, nonlinear, partial differential equations. A critical analysis of the model, which considers complex mechanisms, arbitrary initial distributions, and radical correlation effects, is presented. The method used for preparing a general program for numerical integration of this system of equations on ILLIAC and the accuracy of the method are described. (C.J.G.)

25504 TID-6457

Brooklyn. Polytechnic Inst. Polymer Research Inst. POLYMERIZATION OF VINYL COMPOUNDS IN THE CRYSTALLINE STATE. H. Morawetz. [1959]. 21p. Contract AT(30-1)-1715. OTS.

Gamma irradiation of crystalline vinyl monomers was carried out in evacuated tubes at -78°C . The crystals were warmed and conditions were limited so that the initial polymerization rate was less than 2% per hr. The

solid-state polymerizability of acrylamide, propionamide and K^+ , Na^+ , and Li^+ salts of acrylic and methacrylic acids was studied as a function of radiation dose and time. (C.J.G.)

25505 UCRL-9218

California. Univ., Berkeley. Lawrence Radiation Lab.

MECHANISMS OF RADIATION-CHEMICAL REACTION IN BIOCHEMICAL SYSTEMS. Warren M. Garrison. June 20, 1960. 11p. Contract W-7405-eng-48. OTS.

Current concepts related to mechanism in the radiolysis of aqueous amino acids and peptides are reviewed. Emphasis is given to recent studies of the peptide linkage as a locus of indirect action. It is shown that radiolytic reactions of protein, both in oxygenated and in oxygen-free solutions, lead under appropriate conditions to cleavage of the polypeptide chain. Reaction in oxygenated solution corresponds to a radiation-induced step that gives rise to amide and carbonyl terminal functions at the locus of cleavage. In oxygen-free solutions, cleavage occurs predominantly through postirradiation hydrolysis of acyl imino linkages ($-\text{CO}-\text{N}=\text{C}(\text{R})-$) to give essentially the same final products. Observed differences in the rates of the postirradiation liberation of ammonia for the two cases support the mechanisms proposed. (auth)

25506 NP-tr-474

GRAFT COPOLYMERIZATION OF VINYL MONOMERS BY IRRADIATION. C. Mazzolini. Translated by S. Pease (U.K.A.E.A. Atomic Energy Research Establishment) from *Materie plastiche* 25, 231-47(1959). 53p. (Handwritten MS. copy). JCL.

A review of applied research on the irradiation of polymers in the presence of vinyl monomers for production of grafted copolymers is presented. The mechanism and kinetics of graft copolymerization is discussed along with various techniques of effecting copolymerization. Results of experiments in which various polymers were irradiated in the presence of vinyl monomers are included. Industrial applications are also discussed. (J.R.D.)

25507

UTILIZATION OF HEAVY WATER IN NUCLEAR REACTORS. J. Chenouard. *Bull. inform. sci. et tech. (Paris)* No. 40, 36-47(1960) May. (In French)

In reactors, heavy water undergoes various modifications in its physical chemical properties. These modifications are caused by radioactivation of the atoms forming the molecule, decomposition by the various types of radiation, chemical pollution by the substances with which the water is in prolonged contact, and isotopic pollution by atoms of light hydrogen. Theoretical considerations leading to a more exact representation of the phenomena observed and to more accurate predictions for new reactor types are discussed. A brief description is given of installations designed to maintain the purity of the heavy water. These installations include recombiner for radiolysis gases, water deionizers, and measurement apparatus. (tr-auth)

25508

PRODUCTION OF ORGANOPOLONIUM COMPOUNDS BY USING CHEMICAL ALTERATIONS TAKING PLACE DURING THE β -DECAY OF RaE . A. N. Murin, V. D. Nefedov, V. M. Zaitsev, and S. A. Grachev (Leningrad State Univ.). *Doklady Akad. Nauk S.S.S.R.* 133, 123-5(1960) July 1. (In Russian)

The daughter elements produced by RaE β decay in some aromatic derivatives were separated and identified by a chromatographic method. The polonium from β decay was accumulated in $\text{Bi}(\text{RaE})\text{Ph}_3$ and $\text{Bi}(\text{RaE})\text{Ph}_3\text{Cl}_2$ crystals.

Chemical changes produced by the β decay of RaD in RaDPh₄ were used for preparing high specific activity compounds. Ethyl acetate, carbontetrachloride, and petroleum ether were used for separating tellurium compounds. For organic tellurium compounds chromatographed in ethyl acetate, the R_f values were: TePh₃Cl \approx 0.1; TePh₂Cl₂ \approx 0.50 to 0.55; and TePh₂ \approx 0.70 to 0.75. For carbon compounds chromatographed in tetrachloride the R_f were: TePh₃Cl \approx 0; TePh₂Cl₂ \approx 0.6 to 0.7; and TePh₂ \approx 1. With petroleum ether there was only TePh₂. The general picture of polonium distribution is characterized by PoPh₂Cl₂—15 \pm 6%; PoPh₂—24 \pm 6%, and other polonium derivatives—61 \pm 6%. The polonium distribution of CCl₄ is PoPh₂Cl₂—19 \pm 6%, PoPh₂—18 \pm 6%, and other polonium derivatives—63 \pm 6%. With petroleum ether, the PoPh₂ content was 19 \pm 6%. Crystals of PoPh₂ were not observed in Bi(RaE)Ph₃Cl₂; almost all the polonium (92 \pm 3%) was found as PoPh₂Cl₂. Chromatography with ethyl acetate shows R_f = 0.54. The results indicate that the chemical state of RaE strongly affects the yield of various forms of RaE and can be used for synthesizing organic compounds of polonium. (R.V.J.)

25509

CHEMISTRY OF N¹³ RECOILS IN SOME CARBON COMPOUNDS. Henry Schmied and W. S. Koski (Johns Hopkins Univ., Baltimore). *J. Am. Chem. Soc.* **82**, 4766-70(1960) Sept. 20.

The chemistry of N¹³ recoils produced by the C¹²(d,n)N¹³ reaction in methyl bromide, methyl chloride, chloroform, and carbon tetrachloride was studied. A combination of gas chromatographic and chemical methods was used to analyze the reaction products. The main product in CH₃Br and CH₃Cl was HCN. In HCCl₃, ClCN was found in addition to HCN. In carbon tetrachloride ClCN was the main product. In addition, three other radioactive compounds were observed. Nitrogen, NO₂, and one other unidentified nitrogen-oxygen compound were detected. The compounds probably arise from the reactions of N¹³ with nitrogen and oxygen, which originally were absorbed on the surface of the reaction vessel. No significant amounts of NH₂ were detected indicating that probably no abstraction of hydrogen takes place. (auth)

25510

RADIATION CHEMISTRY OF AQUEOUS FORMIC ACID SOLUTIONS. EFFECT OF CONCENTRATION. Donald Smithies and Edwin J. Hart (Argonne National Lab., Ill.). *J. Am. Chem. Soc.* **82**, 4775-9(1960) Sept. 20.

The radiolysis of formic acid solutions by Co⁶⁰ γ rays at concentrations of 1.0 to 26.6 M pure formic acid, is reported. Carbon dioxide, carbon monoxide, and hydrogen are the sole gaseous products and formaldehyde is a reactive intermediate. G(CO₂) reaches values as high as 12, increases as (HCOOH)^{1/2} at high dose rates, and as (dose rate)^{-1/2} at constant concentration. These results indicate a chain reaction. The reaction sequence explains the chain formation of carbon dioxide. G(H₂) decreases from 3.2 in dilute solutions to 2.4 at 5 to 10 M formic acid and then remains unchanged with increasing concentration. G(CO) rises from zero with increase of formic acid concentration, rapidly at first and then more gradually to 1.25 in pure formic acid. Direct excitation of formic acid by water sub-excitation electrons is suggested as the mechanism explaining the carbon monoxide yields at low concentrations. Some supporting photochemical studies at 1860, 2537, and 2669 Å are reported. (auth)

25511

KINETICS OF THE ALPHA RADIOLYSIS OF CARBON MONOXIDE. P. S. Rudolph and S. C. Lind (Oak Ridge

National Lab., Tenn.). *J. Chem. Phys.* **33**, 705-8(1960) Sept.

The radiolytic decomposition of CO induced by α particles appears to be initiated by two reactive species, CO⁺ and CO. The products of the reaction are CO₂ and the solids (C₃O₂)_x and graphite. Carbon dioxide formed during the reaction depletes the CO⁺ by charge transfer; thus when CO₂ pressure becomes sufficiently high, CO only initiates reaction. The reaction mechanism suggested is consistent with previous ionization and photochemical studies in the CO system. (auth)

25512

DISSOCIATION OF METHYL BROMIDE BY NUCLEAR ISOMERIC TRANSITION OF 4.4-hr Br^{80m}. S. Wexler and G. R. Anderson (Argonne National Lab., Ill.). *J. Chem. Phys.* **33**, 850-7(1960) Sept.

The pattern of positively charged fragments from methyl bromide as a result of isomeric transition of 4.4-hr Br^{80m} was measured by mass spectrometric techniques. A peaked distribution of charge states of atomic bromine ranging from Br⁺ to Br¹³⁺ was observed, the most probable being Br⁷⁺. The finding of single- double- and triple-charged carbon-containing fragments gives evidence that the CH₃Br⁸⁰ daughter ion breaks apart by Coulombic repulsion of redistributed charges following internal conversion and subsequent Auger electron transitions. Multiple-charged polyatomic species produced by the nuclear transition are unstable. (auth)

25513

GAMMA RADIOLYSIS OF PROPANE. B. F. Birdwell and George W. Crawford (Univ. of Texas, Austin). *J. Chem. Phys.* **33**, 928-9(1960) Sept.

Propane gas was irradiated with Co⁶⁰ γ rays. The primary products formed by the decomposition of 0.9 to 3.2% of the original propane were identified. Based on hydrogen yield, the relative yields of the products are hydrogen (1.00), hexanes (0.70), ethane (0.32), methane (0.27), butanes (0.17), and pentanes (0.08). (auth)

25514

EPR OBSERVATION OF STEADY-STATE ETHYL RADICAL CONCENTRATION IN RADIOLYSIS OF LIQUID ETHANE. Richard W. Fessenden and Robert H. Schuler (Mellon Inst., Pittsburgh). *J. Chem. Phys.* **33**, 935-6(1960) Sept.

EPR observations of radicals produced during photolysis and radiolysis have been reported but the second-order rate constants used were considerably less than steady-state. The present study is focused on the steady-state concentration of reactive radicals produced in liquid systems. The EPR spectrum of liquid ethane was examined during irradiation of the sample with 2.5-Mev electrons. The spacing and intensity of the lines indicate that the electron is coupled to one of two groups of equivalent protons and a second group of three equivalent protons. The resulting spectrum consists of four sets of triplets. The second-order rate constant for the recombination of ethyl radicals in ethane is estimated to be 4×10^9 liters mole⁻¹ sec⁻¹. (B.O.G.)

25515

ENERGY TRANSFER IN LIQUID HYDROCARBONS EXCITED BY γ RAYS. G. R. Freeman (Univ. of Alberta, Edmonton, Can.). *J. Chem. Phys.* **33**, 957-8(1960) Sept.

The primary reactions that occur when a solution of benzene B in cyclohexane C is irradiated with γ rays are (1) C—vuv—C', (2) C'—H₂+products, and (3) C'+B—C+B*. The C' and B* represent the excited species. Reaction (3) occurs so rapidly that it is evidently not con-

trolled by molecular diffusion. Similar reactions that occur in scintillator solutions were observed to have rate constants larger than those allowed by molecular diffusion. Several theories that represent the transfer of excitation energy from C'' to B^* indicate that the transfer would be facilitated by an increase in the degree of order among the molecules in the liquid. Experimental observations are compared for methylcyclohexane systems with benzene and cyclohexane in order to clarify the mechanism of reaction (3). Freeman's value of the k_3/k_2 ratio was 0.78 ± 0.11 l/mole, whereas the present experiments resulted in a value of 0.64 ± 0.10 l/mole. An extension of the electron transfer theory of Marcus indicates that there is an inconsistency between theory and the experimental observations. (B.O.G.)

25516

STUDY BY ELECTRONIC PARAMAGNETIC RESONANCE OF VINYL MONOMERS IRRADIATED BY X RAYS IN THE SOLID STATE. R. Marx and M. R. Bensasson. *J. chim. phys.* **57**, 673-4 (1960) July-Aug. (In French)

The radicals formed by x irradiation at 77°K of vinyl monomers are studied by paramagnetic resonance. The spectra obtained near the irradiation temperature are different from those obtained at the same temperature when the monomers are photolyzed in the presence of H_2O_2 . If the samples are slowly heated, the transformation of the free radicals responsible for the paramagnetism and their recombination is observed. After fusion of the samples, the presence of a polymer is observed. (J.S.R.)

25517

THE INTERCEPTION OF RADICALS BY ACRIDINE, ANTHRACENE, AND THEIR DERIVATIVES IN THE RADIOLYSIS OF CARBON TETRACHLORIDE. J. LaPlane and N. Ivanoff (Faculté des Sciences, Paris). *J. chim. phys.* **57**, 675-6 (1960) July-Aug. (In French)

The interceptor behavior of acridine, methyl-9-acridine, anthracene, and benz-1,2-anthracene with respect to the free radicals formed during the radiolysis of pure carbon tetrachloride was studied. Solutions of these substances (2×10^{-5} to 10^{-2} M) in carbon tetrachloride were irradiated with γ rays in the absence of air. The consumption of each of these substances was measured as a function of the dose received. The consumption of acridine was 8 to 11. That of methyl-9-acridine varies linearly with the dose. The consumption of anthracene, measured at three dose intensities as a function of the concentration, shows curves identical to those predicted by theory. The experimental consumption curves for benz-1,2-anthracene as a function of the initial concentration were similar to those found previously. (J.S.R.)

25518

COMPARISON OF TRYPSIN X-IRRADIATED IN SOLUTION AND IN AGAR GELS. E. S. Augenstine, L. G. Augenstine, and E. R. Lippincott (Univ. of Maryland, College Park and Brookhaven National Lab., Upton, N. Y.). *J. Phys. Chem.* **64**, 1211-15 (1960) Sept.

A method was developed to measure the enzymatic activity of trypsin recovered from agar gels. From un-irradiated gels this activity was always less than that from a corresponding solution containing no agar. The amount of trypsin inactivated in gels by a given dose of radiation was much less than that in trypsin solutions where there was no agar. This was contrary to expectations based on previous studies of gels containing dyes. This inhibition of inactivation in agar is presumed to result from an interaction between agar and trypsin. For example, a complex may form such that susceptible sites

of the trypsin are shielded from reaction with radiation-produced radicals. Alternatively, the micellar structure of agar may hinder the trypsin from unfolding once it reacts with a radical. (auth)

25519

γ -RAY INDUCED OXIDATION OF STANNOUS CHLORIDE IN AQUEOUS HYDROCHLORIC ACID SOLUTIONS. Alexander R. Amell (Univ. of New Hampshire, Durham). *J. Phys. Chem.* **64**, 1277-9 (1960) Sept.

Gamma-induced oxidation of Sn(II) in aqueous hydrochloric acid solutions was found to be independent of the concentration of Sn(II), Sn(IV), and irradiation time. The "G"-values found in 3N HCl were 1.50 ions Sn(II)/100 ev. This value was independent of acid concentration above 1.5M but decreased at lower acid concentrations. There was a slight dependence of G upon concentration of chloride. This is postulated as being related to changes in activity and oxidation potentials. The mechanism of the reaction is postulated using previously reported reactions. (auth)

25520

HIGH ENERGY γ -IRRADIATION OF VINYL MONOMERS. II. INFRARED SPECTRA OF RADIATION-POLYMERIZED ACRYLONITRILE. Jett C. Arthur, Jr. and Robert J. Demint (Southern Regional Research Lab., New Orleans). *J. Phys. Chem.* **64**, 1332 (1960) Sept.

In studies of the preparation of polymers of cotton cellulose and acrylonitrile, radiation-polymerized acrylonitrile, having decreased solubility in N,N-dimethylformamide, was produced at higher radiation dosages. The infrared spectra of these polymers and chemically initiated polymers showed no marked differences. This indicated that change in structure probably resulted from a dehydrogenation followed by cross-linking between polymers. (M.C.G.)

25521

A NEW PROCESS FOR CONTINUOUS PRODUCTION OF CARRIER-FREE I^{132} FROM Te^{132} . R. Münze (Zentralinstitut für Kernphysik, Rossendorf, Ger.). *Kernenergie* **3**, 518-21 (1960) June. (In German)

A generator was developed for continuous separation of carrier-free I^{132} from Te^{132} , which is based on β -back-scattering. The apparatus is so outstanding in its simple manipulation, high yield, and great safety of operation that it is suitable for routine production of I^{132} . The radiochemical and chemical purity of the I^{132} produced exceeds that of the products of other known processes. The I^{132} from β decay of elementary Te^{132} is present as 90% iodide. (tr-auth)

25522

CHANGES IN CONDUCTIVITY OF PURE WATER CAUSED BY X-IRRADIATION. K. Schmidt (Max-Planck-Institut für Biophysik, Frankfurt am Main). *Nature* **187**, 931-2 (1960) Sept. 10.

The variation with time of the conductivity of pure, non-degassed water when submitted to pulsed x-irradiation was studied. Results show a periodic change in conductivity. The amplitude of this change is inversely proportional to pulse frequency in the range from 10 to 3000 cps. Two effects seem to be superimposed; these are a reversible increase in conductivity during irradiation which returns to zero after the end of irradiation, and an irreversible rise in conductivity which starts practically instantaneously with irradiation and continues until the end of irradiation. (M.C.G.)

25523

RADIATION-INDUCED NITRATION OF ALIPHATIC HYDROCARBONS. Tyson Rigg (United Kingdom Atomic En-

ergy Authority, Sellafield, Cumb., Eng.). *Nature* **187**, 933 (1960) Sept. 10.

In an irradiated n-dodecane solution containing NO_2 , infrared spectra showed strong R- NO_2 and R-COOH bands. Slight absorption peaks attributed to alkyl nitrite and alkyl nitrate were also found. No changes could be detected in a dodecane solution of NO_2 that was allowed to stand for a similar length of time without being exposed to radiation. The results are in good agreement with previous work on iodine scavenging in oxygen-free hydrocarbons and suggest that one of the most important solvent degradation phenomena in highly active tributyl phosphate-hydrocarbon processes may be radioinduced nitration. (M.C.G.)

25524

ROLE OF OXYGEN IN THE CROSS-LINKING AND DEGRADATION OF DEOXYRIBONUCLEIC ACID BY IONIZING RADIATIONS. Peter Alexander and J. T. Lett (Inst. of Cancer Research, London). *Nature* **187**, 933-4 (1960) Sept. 10.

When deoxyribonucleic acid in dilute aqueous solutions or in the solid state was irradiated, the presence of oxygen did not affect the reaction. With nucleic acid gels having a water content between these two extremes, oxygen was found to exert a pronounced influence on the change produced by irradiation with electrons at 1 Mev. As the water content was increased above 25%, main-chain scission with reduction in molecular weight became the predominant reaction of irradiation in air. When the gels were irradiated in the absence of oxygen, the molecular weight increased until some of the nucleic acid became so highly cross-linked that it no longer dissolved in dilute salt solutions but only swelled. (M.C.G.)

25525

METHOD OF IODINE-132 SEPARATION IN ALUMINUM OXIDE COLUMNS AND THEIR SUITABILITY FOR MEDICAL RADIO-IODINE DIAGNOSIS. Ulrich Feine (Universität, Tübingen, Ger.). *Nuclear-Med.* **1**, 159-66 (1959). (In German)

The method of the I^{132} preparation with chromatographic aluminum-oxide columns and their suitability for medical radioiodine tracer investigations is discussed. This technique represents the simplest and most suitable procedure of I^{132} separation for medical use. (auth)

25526

γ -RAY DECOMPOSITION OF SOLID AMMONIUM NITRATE. Toshiaki Shirai, Nirō Matsuura, Masaru Nishikawa, and Masao Takizawa. *Sci. Papers Inst. Phys. Chem. Research (Tokyo)* **54**, 219-22 (1960) June. (In English)

The radiation decomposition of solid ammonium nitrate by Co^{60} γ rays was investigated. Decomposition products were N_2O , N_2 , H_2O , and nitrite. "G"-values for the production of these gases were estimated. A mechanism for the decomposition of the salt is suggested. (auth)

25527

MASS SPECTROGRAPHIC DETERMINATION OF THE ISOTOPIC COMPOSITION OF OXYGEN IN SULFURIC ACID. V. M. Smirnov and V. I. Karpunin (State Inst. of Applied Chemistry, USSR). *Zavodskaya Lab.* **26**, 831 (1960). (In Russian)

In order to determine the O^{18} content in H_2SO_4 enriched in O^{18} , the 80% solution of the acid was precipitated with BaCl_2 , and the precipitate reduced by calcining it with carbon at 950°C under a vacuum of 10^{-5} to 10^{-6} mm of Hg. The O^{18} content of the resulting CO_2 was determined mass-spectrographically, calculating the concentration according to the formula: O^{18} (at. %) = $(1/2R + 1) \cdot 100$, where R designates the ratio of the heights of peaks corresponding

to masses 44 and 46. In the analyzed samples the O^{18} concentration varied from 1.52 to 1.62 at. %. The difference between the experimental data and calculated concentration was between 1 and 4%. Diffusion through quartz and outgassing of C did not influence the accuracy of the results. (TTT)

25528

IMPROVEMENTS IN OR RELATING TO THE POLYMERIZATION OF A DIENE. (to N. V. de Bataafsche Petroleum Maatschappij). British Patent 847,456. Sept. 7, 1960.

A conjugated diene, e.g., butadiene, can be polymerized without metal or peroxide catalysts by irradiating an aqueous emulsion of the diene with high-energy γ rays or electron beams, the total dose being 10^5 to 10^8 rad. The resulting polymer has a high trans-1,4 structure, has a molecular weight of 5×10^4 to 1.5×10^6 , and can be used as rubber and in preparation of high-impact plastic. Dienes that may be polymerized in the above manner are conjugated dienes having no more than 8 carbon atoms in the molecule and their halo-substituted derivatives. Various emulsifying agents that may be used to prepare the aqueous emulsions for irradiation are given. Seven examples of the above method are given using butadiene, isoprene, and piperylene. (D.L.C.)

Raw Materials and Feed Materials

25529 NP-8978

Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa.

MONTHLY REPORT DEVELOPMENT, JUNE 1960. 19p. (D-60-6).

Carbonate leaching tests were performed on Beaverlodge mill heads (milled during April), on Black Bay Ore, and on Beaverlodge mine samples. The scavenging of uranium from Carbonate barren by sodium-amalgam reduction was studied. A further study of the effect of UNH concentration on sintered density was made on sample precipitation from the uranium solutions of 250 g/l and 690 g/l. The flow properties of a batch of powdered UO_2 produced from a urea precipitation of $\text{UO}_2(\text{NO}_3)_2$ was investigated. Tests to establish optimum reaction rate of maximum sintered density are continuing. Investigation of the pelleting properties of ADU showed that small amounts of HNO_3 greatly improve the mechanical strength of the pellets. (W.L.H.)

25530 TID-6434

Michigan Chemical Corp., St. Louis, Mich.

PILOT PLANT EVALUATION OF A BRAZILIAN YTTRIUM CONCENTRATE AS RARE EARTH PLANT FEED. Report 99. Period covered: March 5, 1957 to June 11, 1957. John R. Morton. Aug. 31, 1957. Revised Oct. 23, 1957. Decl. Feb. 6, 1959. 2p. Project 942. OTS.

A pilot-plant evaluation was made of an yttrium concentrate as a rare-earth plant feed for the ion-exchange separation of pure Y_2O_3 . (C.J.G.)

25531 TID-10105

National Lead Co. of Ohio, Cincinnati.

SUMMARY TECHNICAL REPORT FOR THE PERIOD OCTOBER 1, 1953 TO DECEMBER 31, 1953. J. O. Davis, ed. Jan. 15, 1954. Decl. Mar. 28, 1960. 201p. Contract AT(30-1)-1156. OTS.

Amenability tests were performed on various uranium ore concentrates. A production-scale batch of uranyl nitrate product solution extracted with TBP in the pilot plant was processed to metal. Thirty lots of $\text{UO}_2(\text{NO}_3)_2$ were successfully denitrated in preliminary denitration-pot operation tests. Scrap-plant-product black oxide con-

taining less than 1% fluoride was obtained by maintaining constant temperature and pH and holding temperature over 1500°F. The pilot-plant UF_4 reduction unit has undergone continual improvement of mechanical components while meeting production commitments. A two-stage cyclone dust-collector system was installed which collects 99% of the product (green salt) dust in the off-gas. Reduction to metal in 12-in.-diameter bombs gave the best yields at 1170°F furnace control temperatures. Three molybdenum-uranium alloy ingots were prepared with a molybdenum content of 2.0 wt. %. (W.L.H.)

25532 WAPD-TM-225

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

FURTHER WORK ON THE DIFFUSION OF KRYPTON-85 FROM URANIUM DIOXIDE POWDER. A. B. Auskern. Aug. 1960. 14p. Contract AT-11-1-GEN-14. OTS.

Fission-gas diffusion anneals on two stoichiometric and two nonstoichiometric large-grain uranium dioxide powders indicate a high activation energy (70 to 80 kcal/mole) for diffusion in stoichiometric UO_2 and a lower activation energy (30 to 40 kcal/mole) and higher diffusion coefficients for nonstoichiometric UO_2 . The agreement of the high temperature results for the two different stoichiometric UO_2 powders with results on dense UO_2 plates is good. Anneals for short times, where the emanation rate can be more rapid than that governed by true lattice diffusion, can result in diffusion coefficients that are too large. This rapid initial emanation can result from surface cracks or a thin surface layer of high-oxygen content. (auth)

25533

IMPROVEMENTS IN OR RELATING TO RECOVERY OF THORIUM BY MEANS OF OXALIC ACID. Gillian Mary Carter, David Anthony Everest, and Ronald Alfred Wells (to United Kingdom Atomic Energy Authority). British Patent 843,206. Aug. 4, 1960.

An improved method is given for the separation of thorium by oxalate precipitation from acid leach liquors obtained from thorium-bearing ores containing rare earths and phosphates, e.g., monazite, by H_2SO_4 treatment. The method yields thorium with a relatively low proportion of rare earths. Oxalic acid is added in a molar amount 3 to 5 times that of the dissolved thorium with the liquor at 4.8 to 5.5 N with respect to total acid. The precipitate can be purified from its phosphate and its thorium/rare earths ratio can be further increased by digesting with aqueous H_2SO_4 containing oxalic acid. Seven applications of the above method are given, one of which gave a final precipitate containing 8.78 g ThO_2 and 2.63 g rare-earth oxides from a monazite sand of 7.65% ThO_2 and 55.5% rare-earth oxides. (D.L.C.)

25534

SINGLE-STEP CONVERSION OF UO_3 TO UF_4 . J. E. Moore (to U. S. Atomic Energy Commission). U. S. Patent 2,944,873. July 12, 1960.

A description is given of the preparation of uranium tetrafluoride by reacting a hexavalent uranium compound with a polysaccharide and gaseous hydrogen fluoride at an elevated temperature. Uranium trioxide and starch are combined with water to form a doughy mixture, which is extruded into pellets and dried. The pellets are then contacted with HF at a temperature from 500 to 700°C in a moving bed reactor to produce UF_4 . Reduction of the hexavalent uranium to UO_2 and conversion of the UO_2 to UF_4 are accomplished simultaneously in this process.

Separation Processes

25535 AERE-M-698

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE USE OF DI-AMYL PHOSPHONATE (DAAP) AS AN ALTERNATIVE EXTRACTANT TO TBP. L. E. Marc de Chazal and A. R. Lister. May 1960. 4p. BIS.

Partition data were obtained under identical conditions using 20% diamyl amyl phosphonate (DAAP)/OK and 20% tri-N-butyl phosphonate (TBP)/OK equilibrated with Windscale primary separation plant feed solution with added natural uranium solution. The results that are presented show that DAAP is the superior extractant for uranium and plutonium recovery. However, since it also extracts gamma-emitting impurities more strongly than TBP, more stages would be required to achieve a given amount of decontamination. (W.L.H.)

25536 ANL-6117

Argonne National Lab., Ill.

THE FLUORINATION OF URANIUM FROM DRIED SOLIDS AND ITS APPLICATION TO THE FLUORIDE VOLATILITY PROCESS. Carl E. Johnson and Jack Fischer. Aug. 1960. 19p. Contract W-31-109-eng-38. OTS.

The fluorination of uranium from dried solids representative of those obtained from the fluid-bed drying of dissolver solutions of high zirconium alloy fuels, e.g., Dresden and Army Package Power Reactor fuels, was studied under a variety of conditions. Variables investigated were particle size, additives, temperature, time, hydrofluorination, and pyrolysis. Temperatures in excess of 650°C were needed to ensure complete removal of uranium from the solid. Pyrolysis with HF of previously fluorinated materials aided in uranium removal from the zirconium solid. (C.J.G.)

25537 CF-60-7-65

Oak Ridge National Lab., Tenn.

ENGINEERING EVALUATION OF VOLATILITY PILOT PLANT EQUIPMENT. F. W. Miles and W. H. Carr. Sept. 30, 1960. 393p. OTS.

The operation of the ORNL Volatility Pilot Plant for decontaminating and recovering uranium from molten-salt reactor fuels is discussed. A description of equipment, operating details, and performance of each system within the plant is contained. (C.J.G.)

25538 DP-479

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

REPROCESSING OF POWER REACTOR FUELS. Quarterly Progress Report No. 9 [for] October 1, 1959 to January 1, 1960. Leon H. Meyer, comp. Mar. 1960. 12p. Contract AT(07-2)-1. OTS.

Pressure and mechanical vibration are effective in maintaining continuous anodic dissolution in HNO_3 of stainless steel contained in an electrolytically inert anode basket. Zirconium metal can be electrolytically disintegrated in HNO_3 by the same technique; in this case 85% of the zirconium precipitates as ZrO_2 and only 15% remains in solution. When Zr-10% U alloy is electrolytically disintegrated in HNO_3 , 60 to 80% of the zirconium precipitates as ZrO_2 , carrying 10% or more of the uranium. The constituents of a charge of PRDC elements, zirconium and U-Mo alloy, were dissolved in a two-step process with HNO_3 and HF. The rate of dissolution of irradiated PRDC fuel is one to two times that of unirradiated fuel. (For preceding period see DP-439.) (auth)

25539 GAT-P-18

Goodyear Atomic Corp., Portsmouth, Ohio.

COMPLEXING FLUORIDE IONS WITH ALUMINUM METAL.

R. A. Holthaus, J. R. Davis, and E. C. Bender. Aug. 23, 1960. 5p. Contract AT(33-2)-1. OTS.

In the recovery of uranium from salt concentrations by solvent extraction, $\text{Al}(\text{NO}_3)_3$ is added to complex fluorine ions. Studies revealed that aluminum metal functioned as effectively as $\text{Al}(\text{NO}_3)_3$ in complexing the fluorides. Extraction column efficiencies were excellent, no evidence of excessive corrosion was noted, and raffinate reruns were eliminated. (C.J.G.)

25540 HW-60823

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

TROUGH-TRAY DISSOLVER. R. W. McKee. June 26, 1959. 18p. Contract AT(45-1)-1350. OTS.

The design and performance of a trough-tray dissolver are described. In this design a number of troughs are combined into a single tray by placing them side by side in a horizontal plane and connecting them together. Each trough is sized to be geometrically safe for a heterogeneous 5% U^{235} system, and each trough is separated from the next by a moderator and neutron absorber. Advantages of the system are pointed out. (J.R.D.)

25541 NLCO-815

National Lead Co. of Ohio, Cincinnati.

STUDIES OF THE BEHAVIOR OF THE TBP-KEROSENE SOLVENT IN URANIUM REFINING: QUALITY EVALUATION AND TREATMENT TECHNIQUES FOR USED SOLVENT. Robert K. Klopfenstein, Jerome H. Krekeler, Nelson R. Leist, Clark T. Hicks, Donald E. Richards, and Joseph R. Nelli. July 15, 1960. 30p. Contract AT(30-1)-1156. OTS.

A rapid, simple procedure has been formulated for evaluating used tri-*n*-butyl phosphate (TBP)-kerosene solvents. Three criteria of solvent condition—uranium retention, coalescence time, and infrared spectral analysis—have been incorporated. A number of chemical and adsorbent treatment techniques for used or degraded TBP-kerosene solvent have been investigated. The use of adsorbents has been shown to be economically unattractive and operationally impractical owing to the fact that adsorbents owe their primary effectiveness to their ability to dry the solvent. In terms of uranium, DBP and diluent degradation product removal, coalescence time reductions, and the non-formation of precipitates or gases during use, sodium carbonate has been shown to be the most practical chemical-solvent treatment agent. The refinery-solvent treatment systems have been modified to include centrifuges after sodium carbonate washing, in lieu of water washing, resulting in increased capacity and effectiveness of treatment with decreased solvent entrainment losses and solvent deterioration. (auth)

25542 ORNL-2993(p.1-57)

Oak Ridge National Lab., Tenn.

HEAD-END AND SOLVENT EXTRACTION PROCESSING.

Development of the Sulfex and Darex processes for de-cladding Consolidated Edison fuel (stainless-steel-clad ThO_2 - UO_2 pellets) was continued. Consolidated Edison ThO_2 - UO_2 fuel pellets can be dissolved in either boiling Thorex dissolvent [13 M HNO_3 —0.04 M NaF —0 to 0.1 M $\text{Al}(\text{NO}_3)_3$] or Darex de-cladding solution that has been stripped free of chloride and adjusted to 0.04 M NaF , 0 to 0.1 M Al , and 12 to 13 M H^+ . The chief variable in ThO_2 - UO_2 dissolution in Thorex dissolvent was pellet density: the initial dissolving rate in 200% excess dissolvent varied

from 16 $\text{mg min}^{-1} \text{cm}^{-2}$ for pellets whose density was 60% of theoretical to 2 $\text{mg min}^{-1} \text{cm}^{-2}$ for material whose density was 94% of theoretical. Cyclic Sulfex-Thorex and Darex-Thorex dissolvings, in which a 10 to 20% oxide heel was carried over into subsequent cycles, were found practical with an 8- to 10-hr core-dissolution time. Thorium and uranium losses were less than 0.25% in all runs. Heel build-up was more pronounced in Sulfex operation, in which a 20% heel remained after four runs, compared with a 10% heel after four Darex cycles. The Darex process for complete dissolution of UO_2 -stainless-steel fuels was demonstrated in hot-cell experiments with Yankee Atomic fuel irradiated to 16,000 Mwd/ton; all operations were completely satisfactory. Fuels bonded with sodium or NaK cannot be processed by the Darex process; violent vapor-phase reactions occur between the nitrogen oxides and hydrogen. The Zirflex process for de-cladding PWR blanket elements (UO_2 pellets clad in Zircaloy-2) was demonstrated with fuel irradiated up to 1750 Mwd/ton. Uranium and plutonium losses to the 6 M NH_4F —1 M NH_4NO_3 de-cladding solution increased with increasing burnup. However, losses at maximum burnup were only 0.04 and 0.08%, respectively. Ammonia generated by the de-cladding reaction must be removed from the system to avoid formation of a $\text{ZrO}_2 \cdot \text{H}_2\text{O}$ sludge. Uranium-zirconium alloy fuels containing up to 10% uranium may be dissolved in 5.4 M NH_4F —0.33 M NH_4NO_3 —0.13 M H_2O_2 (modified Zirflex process). Uranium-3% molybdenum alloy is dissolved in boiling 8 M HNO_3 —0.5 M $\text{Fe}(\text{NO}_3)_3$ to yield a completely stable product solution, containing 1 M uranium, which is suitable as a feed for the Purex solvent-extraction process. The disadvantage of this method is the generation of about 1100 gal of first-cycle solvent-extraction waste for each ton of uranium processed. An alternative aqueous process, proposed for U-10% Mo alloys, involves dissolution of the alloy in boiling 11 to 13 M HNO_3 and separation of the precipitated molybdenic oxide by centrifugation. The SRE de-cladding facility in Cell A of Building 3026 was completed and successfully cold tested on unirradiated SRE fuel rods. The facility will be used to de-clad the SRE Core 1 fuel as soon as building changes for containment are completed. Experimental tests on the shearing of stainless-steel-clad UO_2 fuel bundles both at ORNL and under two subcontracts were completed. The tests indicated the feasibility of the shear-and-leach approach to mechanical processing of fuels, and a 250-ton shear for hot-cell use was designed and is now being fabricated. A new method was developed for processing of uranium-graphite fuels. The fuel is simultaneously disintegrated and leached with 90% nitric acid at either boiling or room temperature. One 4-hr leach at 25°C recovered about 98% of the uranium; recoveries in two leaches were about 99 and 99.5% from fuels containing 1.5 and 13% uranium, respectively. In further work on the Hermex process the solubilities of U, Th, Pu, Sm, Nd, and Gd in mercury and of Ru, Pd, Zr, and Mo in uranium-saturated mercury solutions were measured from 25 to 356°C. A Hermex flowsheet for UO_2 fuel was also developed in which decontamination factors (DF's) from Ru, Cs, and Sm of > 1000, 220, and 75, respectively, were obtained. The major development in the solvent extraction subprogram was the development of an acid-salted acid-deficient Thorex process. The advantages of this over the old aluminum-salted process are the production of a waste that contains < 0.1 M Al and may be reduced tenfold or more in volume, the 50% decrease in pulsed-column stage heights, and the assurance that uranium and thorium losses and fission-product DF's will be equal to or better than those in the older process. The new flowsheet can be used for either a co-

decontamination or a partitioning first cycle for uranium and thorium. Amsco washing of the evaporator feed to prevent carry-over of TBP hydrolysis products produced in intercycle evaporation was evaluated. Hot-cell demonstrations of the Yankee and NMSR Darex-Purex flowsheet were made with fuel samples irradiated to 16,000 Mwd/ton. Two-cycle DF's were 7.4×10^5 and 1.2×10^5 for gross beta and gamma, respectively; these are lower than the anticipated values, and more tests are planned. A flowsheet was developed for recovering enriched uranium from the LAPRE-II fuel which contains 77 g U(IV) per liter in 96.8% H_2PO_4 . The 12-fold dilution required for criticality control (to 6 g of uranium per liter) is sufficient to provide satisfactory feed if the solution is made 1.6 M in $Fe(NO_3)_3$ to ensure complexing of the phosphate. Engineering-scale tests on unirradiated fuel solutions were made to determine flooding and HETS values for sieve plates, nozzle plates, and nozzle-zebra plates with the interface at top and bottom of the columns. Flooding characteristics in extraction-scrub columns were best with nozzle plates; the scrub section was controlling. Nozzle plates were also less subject to upset by interface "cruding" or particulate matter in the feed. Sieve plates used in either extraction or stripping and with the interface at either top or bottom gave uranium extraction HETS values that were independent of pulse rate. (auth)

25543 ORNL-2993(p.58-67)

Oak Ridge National Lab., Tenn.

POWER REACTOR FUEL PROCESSING PILOT PLANT.

A total of 50.6 tons of natural and depleted irradiated-uranium fuel from the BNL, SR, and HW reactors was processed to recover 39.4 kg of plutonium and 37 tons of uranium. Special programs, such as the processing of ANL-CP-2 reactor fuel and MTR irradiated plutonium-aluminum alloy assemblies (containing 30% Pu^{240}), were completed. The raffinate from the MTR plutonium-aluminum program was processed to demonstrate a scheme aimed at recovering the rare earth-amercurium-cerium fraction. A nonionic (polymeric) species of plutonium, in-extractable in TBP and undetectable with normal analytical methods, was formed in three batches of Savannah River dissolver solution, which progressed to conditions of 2.0 M HNO_3 to 0.5 M acid deficiency, causing significant deviations in the plant material balances. Complexing agents and prolonged digestion in an acid environment (>2 M HNO_3) were required to reconvert the plutonium to the extractable state. Fission-product decontamination was improved by operating the extraction contactors with the organic phase continuous. Two methods of column interface control were developed and demonstrated. An evaporator explosion on November 20 in Cell 6 of the Hot Pilot Plant, Building 3019, resulted in release of 70 mg of plutonium to nonoperating areas of Building 3019 and of 600 mg to nearby streets and buildings. No one was injured as a result of the explosion, and no one received a significant fraction of a lifetime body burden of plutonium either at the time of the incident or during subsequent cleanup operations. The explosion is considered due to the deflagration of nitrated organic compounds in an intercycle evaporator which was being decontaminated and involved nitration by concentrated nitric acid of 14 liters of the proprietary decontaminating agent, Turco 4501. In the cleanup operation the contamination was bonded to the nearby street and building surfaces with tar, paint, roofing compound, or masonry sealer, as appropriate to the surface. With the exception of the pilot-plant section of Building 3019, the Graphite Reactor building, and the road south of these buildings, all areas of the Laboratory were back in service by Monday, Nov. 23. Decontamination

of the interior of Building 3019, exclusive of four of the seven processing cells, was 90% complete on Aug. 1, 1960. Decontamination of the processing cells is being delayed pending installation of a temporary secondary containment structure and provision of additional vessel off-gas capacity. (auth)

25544 ORNL-2993(p.68-74)

Oak Ridge National Lab., Tenn.

FUSED SALT-FLUORIDE VOLATILITY PROCESS.

The pilot plant originally designed for volatility processing of fused-fluoride fuel was converted (by addition of a dissolver and other equipment) to use with zirconium-containing solid fuels. In tests on an INOR-8 prototype dissolver, corrosion was not detectable by Vidigage inspection after 10 hydrofluorination runs with Zircaloy-2 bars totaling 74.5 hr of exposure to HF-sparged $NaF-LiF-ZrF_4$ melts at 550 to 650°C. It was observed that Ni, Cr, Sn, and Fe dissolved in the molten-salt solvent as impurities were reduced by reaction with zirconium. Part of the metallic impurities was deposited on the fuel specimen being dissolved; this tended to retard the dissolution. Some of this finely divided material was also entrained in the off-gas, complicating the off-gas disposal problem. This problem can be minimized by keeping the impurities content of the salt low. This can be accomplished by pretreating the molten-salt solvent with hydrogen and using a mixture of hydrogen and HF as the reactant gas for dissolution. Hydrogen fluoride dissolution-rate data obtained for a copper-lined dissolver showed a small effect of temperature and a nonlinear effect of ZrF_4 bulk concentration and corroborated the major dependence of dissolution rate on the superficial velocity of gas past fuel surfaces. Adiabatic differential-bed studies of the UF_6 sorption on NaF indicated an initial period when gas-phase diffusion controlled the rate, followed by a longer period in which solid-phase diffusion was the controlling factor. A series of 12 laboratory-scale tests on the Fused Salt-Fluoride Volatility process with long-decayed Nautilus STR fuel demonstrated good uranium recovery and over-all decontamination from fission product activity but showed the necessity for further work to reduce the amounts of molybdenum, technetium, and neptunium in the UF_6 product. The feasibility of processing stainless-steel- and niobium-containing fully enriched uranium fuels by the Fused Salt-Fluoride Volatility process was suggested by measurements of acceptable dissolution rates with HF in fused salt mixes. ThO_2 dissolved rapidly without HF in ZrF_4 -bearing salt mixes, by metathesis or the formation of the soluble oxyfluorides. The feasibility of gaseous transfer of PuF_6 was demonstrated, indicating a possible method of separating UF_6 and PuF_6 based on their relative chemical stabilities. Work on the MoF_6 -NaF system proved that a definite chemical complex exists between these compounds, and preliminary vapor pressure data were obtained on the equilibrium between gaseous MoF_6 and the solid complex. (auth)

25545 ORNL-2993(p.75-6)

Oak Ridge National Lab., Tenn.

MOLTEN SALT REACTOR FUEL PROCESSING.

A study of potential fuel-cycle costs as related to conversion ratios for various fuel-processing rates indicated that a total fuel-cycle cost of ~ 1 mill/kwhr can be achieved, with a minimum at a conversion ratio of slightly less than 1.0, assuming that the volatility process can be extended to apply to fuels decayed only 4 days. Economically the fluoride volatility process appears to be acceptable for uranium recovery from fuel and blanket salts and the HF dissolution process for Li^+ salt recovery for fuel

neutron-poison-level control. However, much experimental work must be accomplished before the volatility process is proved to be technically feasible for molten-salt-breeder application. Scouting chemical investigations for alternative processes indicated that a solution of 5 mole % NO_2 in anhydrous HF might be used as a solvent for the whole fused $\text{LiF-BF}_3\text{-UF}_4$ fuel, the components having solubilities of about 50, 50, and 1 g/liter. High-cross-section rare-earth fission-product fluorides and ThF_4 are insoluble in this solvent; rare earths are soluble to the extent of $< 10^{-4}$ mole %, only, and ThF_4 to < 0.01 mole %. (auth)

25546 ORNL-2993(p.77-82)

Oak Ridge National Lab., Tenn.

HOMOGENEOUS REACTOR FUEL PROCESSING.

In initial tests with a 13-unit multiple hydroclone unit, solids-collection rates averaged 50 to 100% higher than with a single hydroclone. Plugging was eliminated by returning the overflow from the collection hydroclone to the multicclone receiver. Analysis of samples for I^{135} and measurement of heat-generation rates on the low-pressure system iodine trap confirmed previous observations that 80 to 99% of the iodine in the high-pressure system does not continuously circulate with the fuel, but is retained, probably by adsorption on pipe surfaces, in equilibrium with that in solution. This decreases the effectiveness of the iodine-removal system, but xenon poisoning may still be limited to acceptably low levels by iodine removal. The xenon-poison fraction at 5 Mw was found, by mass spectrographic analyses of the reactor off-gas downstream of the charcoal beds, to be 0.9%. (auth)

25547 ORNL-2993(p.83-96)

Oak Ridge National Lab., Tenn.

WASTE TREATMENT AND DISPOSAL.

Processes under development to prepare wastes for permanent disposal would convert high-radioactivity-level wastes to solids by evaporation and calcination; solidify intermediate-level chemical decladding wastes with lime, sand, and cement; and decontaminate low-level wastes to dischargeable levels by ion exchange. Evaporation and calcination to 900°C of synthetic high-level wastes was studied in 4-in.-diameter 18-in.-long pots and in 6- and 8-in.-diameter 78-in.-long pots. In the smaller equipment $> 98\%$ of the original nitrate in the feed was recovered in the off-gas condensate, and total noncondensable inerts in the off-gas amounted to 0 to 5 liters per liter of feed, depending on the method of operation and the atmosphere maintained in the system. In the larger equipment, solids deposition in the pot took place either in a radial or vertical direction, depending on the method of operation. Evaporation and calcination of simulated Purex 1WW to 400°C in the presence of 3 to 300 ml of TBP per liter of waste produced no exothermic and/or violent reaction. Measured thermal conductivities of calcined wastes varied almost linearly with temperature from 0.210 at 90°F to 0.311 $\text{Btu hr}^{-1} \text{ft}^{-1} (^\circ\text{F})^{-1}$ at 1329°F for calcined Purex waste and from 0.140 at 92°F to 1.52 at 1600°F for a calcined Darex waste. Evaporation and calcination of Purex 1WW in an NO atmosphere decreased the ruthenium in the condensate from about 70 to 0.9 to 1.5% without additives and to 1.9 to 32% with additives. The presence of about 2 ml of TBP per liter of waste decreased the amount of ruthenium in the condensate, in an air atmosphere, from about 70 to 4 to 15%, depending on additives. Decontamination of an air stream bearing a soluble aerosol by a packed scrubber was as much as 1000 times more effective when steam was present in the vapor phase. Fundamental data on the physical and chemical changes that take place when various components of waste

solutions are heated during calcining are being obtained by thermogravimetric analysis. Based on compression tests, satisfactory methods were found for solidifying Sulfex and Zirflex decladding wastes by addition of $\text{Ca}(\text{OH})_2$, sand, and cement to the waste solutions. Making typical ORNL low-level process-water waste 0.01 M in NaOH, filtering it, and then passing it through a phenolic cation-exchange resin bed results in over-all decontamination factors of about 10 for ruthenium and cobalt, 100 for rare earths, and 1000 for cesium and strontium. The resin can be regenerated with hydrochloric acid, and the regenerant waste evaporated to about 1/3000th of the original waste-water volume. A study of the economics of permanent tank storage of power-reactor fuel processing wastes indicates that storage costs should average 0.05 to 0.23 mill/kwhr (electrical); this cost does not reflect the hazards involved. (auth)

25548 ORNL-2993(p.103-5)

Oak Ridge National Lab., Tenn.

AMEX PROCESS.

Uranium was recovered economically from amine extracts as a high-assay product free of sodium, molybdenum, and vanadium by precipitating ammonium uranyl tricarbonate from the solvent phase with a uranium-saturated ammonium carbonate-ammonium sulfate solution and calcining the precipitate. Another stripping method, which recovers uranium from amines as a relatively pure concentrated uranyl nitrate solution rather than as the usual solid concentrate, was demonstrated successfully in continuous equipment. Favorable results were obtained in solvent-extraction recovery of uranium from relatively pure carbonate solutions with a quaternary ammonium extractant, but attempts to treat an actual feed liquor from a Colorado Plateau ore were unsuccessful owing to interference from impurities in the liquor. (auth)

25549 ORNL-2993(p.106-7)

Oak Ridge National Lab., Tenn.

THORIUM RECOVERY FROM GRANITIC ROCKS.

In studies on recovering thorium from Canadian uranium-thorium ores, an inexpensive method was developed for stripping thorium from Primene JM-kerosene by contacting the extract with 2 M NaCl-0.5 M Na_2SO_4 solution and subsequently heating the strip solution to precipitate thorium sulfate. Studies were initiated to define methods and costs for recovering thorium from granitic rocks in tonnages adequate to satisfy the long-range demands of a nuclear power system based on the Th- U^{233} cycle. In preliminary sulfuric acid leaching tests on 12 granitic rock samples containing 10 to 90 ppm thorium, recoveries ranged from 25 to 80%. Sulfuric acid consumption was high, ranging from 40 to 100 lb per ton of granite. Tentative estimates indicate that thorium might be recoverable from the more easily leached, higher grade granites at costs below \$100 per lb. (auth)

25550 ORNL-2993(p.136-43)

Oak Ridge National Lab., Tenn.

TRANSURANIUM STUDIES.

A solvent-extraction flowsheet was developed on a laboratory scale for recovering plutonium, americium, and curium from highly irradiated Pu-Al alloy. In the pilot plant the first plutonium recovery cycle was successfully demonstrated, and results indicated that the americium-curium recovery cycle was operable although it was terminated because of mechanical difficulties before equilibrium conditions were reached. A process for separating actinides from lanthanides by anion exchange based on selective chloride complexing was developed and tested on a labora-

tory scale. The americium, curium, and rare earths were sorbed on Dowex 1-10X resin from a solution of 8 M $LiNO_3$; the rare earths were selectively eluted with 10 M $LiCl$, and the americium-curium with 1 M $LiCl$. In laboratory demonstrations this process gave greater than 99.5% recovery of americium tracer, which contained no detectable amounts of rare earths. Rare earths were separated from americium by selective extraction into 0.5 M mono-2-ethylhexyl orthophosphoric acid from slightly acid 10 M $LiCl$. Gram amounts of rare earths were extracted from milligram amounts of americium in a countercurrent "mini" mixer-settler with 7 scrub and 8 extraction stages. Extractions of neodymium, cerium, and lanthanum were 99.9, 98, and 90%, respectively, whereas americium loss by extraction was 0.04%. Complete separation of curium and lanthanum by this extraction system does not appear to be feasible; however, complete separation from all other rare earths can be accomplished. Americium and curium were concentrated by extraction into 100% TBP from concentrated $LiCl$ solution. Americium chloride solution containing 170 g of americium was successfully converted to pure AmO_2 , which assayed at the theoretical value of 88.3% americium. A program to test the compatibility of plutonium and americium oxides in matrices of aluminum and beryllium was initiated. Preliminary work is being performed with CeO_2 . Conceptual design and cost estimates were completed for the Transuranium Processing Facility; present plans call for construction to begin by September 1961. Equipment design was started. (auth)

25551 ORNL-2993(p.144-8)

Oak Ridge National Lab., Tenn.

FISSION PRODUCT RECOVERY.

A chemical flowsheet is proposed for recovery of strontium and rare earths from Purex wastes. The iron in the waste is first complexed with tartrate, and the pH is adjusted with caustic. Strontium and rare earths are extracted by a solvent comprised of di(2-ethylhexyl) phosphoric acid-tributyl phosphate-Amsco 125-82 and are stripped with nitric acid. Processing the strip product through additional solvent-extraction cycles yields separate concentrated strontium and rare-earth fractions. In preliminary tests, two solvents, sodium tetraphenyl boron in hexone and dinonyl naphthalene sulfonic acid in Amsco 125-82, have shown ability to extract cesium from adjusted Purex waste solutions. Dowex 50W X-8 (20 to 50 mesh) resin was used to recover separate strontium and rare-earth products from a synthetic Purex waste solution on a laboratory scale. The solution is diluted by a factor of 10, and oxalic acid is added prior to pumping it through a column of the resin. Strontium is separated from rare earths by eluting with 1 M HNO_3 and passing this product stream through a second resin column. The rare earths are recovered by eluting with 0.5 M monosodium citrate (pH 3.5). Strontium is recovered by eluting with 1 M $NaCl$ and 0.07 M sodium Versenate at pH 6.1. (auth)

25552 ORNL-2993(p.149-74)

Oak Ridge National Lab., Tenn.

SOLVENT EXTRACTION TECHNOLOGY.

Di-sec-butyl phenylphosphonate (DSBPP) showed U/Th separation factors about 34 times greater than those obtained with TBP. Uranium and thorium complexes of DSBPP were found to be soluble in carbon tetrachloride. Irradiation tests with 1 M TBP solutions in aliphatic Amsco 125-82 and aromatic Solvesso 100 showed the latter to provide radiation protection for the TBP reagent. By measuring the comparative organic-acid production it was shown that the TBP-Solvesso solution was more stable by a

factor of 2.5 to 3 than TBP-Amsco 125-82. DSBPP-Solvesso 100 in similar testing was more radiation stable and showed slightly better uranium-fission-product separation than TBP-Solvesso 100 by factors of ~ 1.5 in each case. A "nitrite-acetone" head-end treatment of the aqueous-process feed solution is tentatively suggested as a technique for improving zirconium-niobium and ruthenium decontamination in the Purex co-decontamination cycle. Results of countercurrent tests with TBP and DSBPP indicated that the decontamination factors were improved by an order of magnitude. Systematic study of plutonium extraction from nitrate solutions continued, including measurement of extremely high Pu(IV) extraction coefficients with dialkylphosphoric acid and useably high coefficients for reduced plutonium from salted solution with tertiary amine. Studies on the amine extraction of fission-product and corrosion-product metal nitrates showed that Mo(VI) is extracted in direct competition with nitric acid, its extraction coefficient with 0.1 M amines decreasing from > 100 at $\sim 0.1 M$ HNO_3 to $< 10^{-4}$ at 2 to 10 M HNO_3 . Zirconium extraction coefficients increased with increasing nitric acid, in approximate accordance to the expression $E_a^0(Zr) = K(M_{amine}^2)(M_{H^+}^2)(M_{NO_3^-}^2)$, with $K \approx 6 \times 10^{-8}$ for trialkylamine and Primene JM-T in toluene. Extraction coefficients of aged nitrosylruthenium nitrate increased with extraction contact time for several hours. The coefficient measured at 24 hr was 0.08 with 0.4 M trialkylamine in toluene from 2 M HNO_3 , and it varied directly with the amine concentration and inversely with the acidity. Samarium(III) extraction coefficients were all $< 10^{-4}$ with 0.3 M amine in toluene from 2 to 9 M HNO_3 . A chemical flowsheet for tertiary amine extraction was developed for recovery of the technetium and neptunium that accumulate in some uranium-fluorination plant residues, together with recovery of the uranium for recycle. Americium was extracted preferentially to the light rare earths from concentrated lithium chloride solutions by tributyl phosphate (TBP), giving the most promising separation observed thus far for the transplutoniums from fission-product rare earths. A 12-stage batch countercurrent extraction with 1 M TBP from 10 M $LiCl$ -0.1 N HCl gave a separation factor of 310 between americium and europium. The order of extraction was similar with several phosphonates, with slightly less separation. Americium was extracted between cerium and europium by several amines. TBP-Amsco 125-82 solutions were degraded chemically with nitric acid and radiolytically by Co^{60} gamma irradiation in order to simulate used radiochemical process extractants. The extent of degradation and the effectiveness of solvent cleanup were assessed by the extraction and stripping of Zr^{95} - Nb^{95} and of Ru^{106} . Measurements of the sulfuric acid transferred to the aqueous phases upon extraction of known quantities of thorium sulfate by di-n-decylamine sulfate-bisulfate mixtures of known bisulfate content indicated an amine sulfate to thorium sulfate ratio of slightly less than three for the complex, in good agreement with the value indicated by isotherm plateaus. These results were in conformity with an equilibrium expression for the extraction which takes into account the effect of varying sulfuric acid activity. An equilibrium constant for this reaction, as well as an independent evaluation of the composition of the complex, was obtained from a least-squares treatment of extraction data from runs at varying sulfuric acid activity but at constant sulfate ion concentration. At constant composition of the organic phase, but with varying aqueous sulfate ion molarities, the distributions were shown to lead to the following values for the formation constants of the thorium trisulfate and tetrasulfate complexes, adjusted to zero ionic

strength via single-parameter Debye-Hückel ionic-strength corrections: $K_{23} = [\text{Th}(\text{SO}_4)_3^-]/[\text{Th}(\text{SO}_4)_2][\text{SO}_4^-] = 6$, $K_{34} = [\text{Th}(\text{SO}_4)_4^{2-}]/[\text{Th}(\text{SO}_4)_3^-][\text{SO}_4^-] = 0.005$. Continued examination of solvent-extraction systems for anomalous equilibria due to violence of agitation during equilibration, other than those reported previously for uranium extraction by trioctylamine sulfate and didecylamine sulfate (DDAS), has resulted in definite evidence of such behavior in two additional systems (thorium extraction by DDAS and uranium extraction by 1,3-ethylpentyl-4-ethyloctylamine sulfate). (auth)

25553 ORNL-2993(p.175-82)

Oak Ridge National Lab., Tenn.

EXTRACTION REAGENT PERFORMANCE.

The presence of nitric acid had no significant effect on the yield of acidic-degradation products formed by irradiation of TBP-Amsco 125-82 solutions. The G value for nitric acid decomposition was high, being in the range 2.5 to 5.5 instead of 0.03 to 0.2 molecule/100 ev that could be expected under these conditions. The use of an aromatic diluent, Solvesso-100, decreased the yield of acid-degradation products from a 1 M TBP solution to about 0.3 molecule/100 ev, which is only 30 to 50% greater than the amount under similar conditions from di-sec-butyl phenylphosphonate, the solvent most resistant to radiation damage of those tested so far. Solubilities of a zirconium dibutyl phosphate, uranyl mono- and dibutyl phosphates, and iron(III) dibutyl phosphate in acid aqueous and 1.13 M TBP-Amsco 125-82 solution ranged from 4×10^{-6} M zirconium dibutyl phosphate in water to 0.7 M uranyl dibutyl phosphate in the most acid organic phase tested. Laboratory tests indicated that low-pressure and molecular distillation are both technically feasible methods for repurifying degraded solutions of TBP in Amsco 125-82. (auth)

25554 ORNL-2993(p.187-93)

Oak Ridge National Lab., Tenn.

ION EXCHANGE TECHNOLOGY.

Dowex 50W X-12 (100 to 200 mesh) resin irradiated to 12.5 whr/g of dry resin by sorbed Pm^{147} was analyzed for radiation effects. Moisture content increased from ~40% to ~70%, corresponding to a decrease in cross-linking from 12% to ~4%. The resin acquired some weak acid capacity, in addition to its salt-splitting capacity. The rate of uranyl sulfate loading on sulfate- and nitrate-equilibrated Dowex 21K anion exchange resin was measured by a single-bead technique. The data were used to calculate apparent uranium-diffusion coefficients by considering the process as simple diffusion into a sphere. These apparent coefficients appear to be nearly independent of the loading solution concentration over the range studied but dependent on the particle size of the resin used. The apparent coefficients observed during loading on sulfate-equilibrated 1200-, 960-, and 820- μ Dowex 21K were 1.3×10^{-7} , 0.76×10^{-7} , and $0.49 \times 10^{-7} \text{ cm}^2 \text{ sec}^{-1}$, respectively. Self-diffusion coefficients for sulfate ions in the resin were $(1.27 \pm 0.25) \times 10^{-6}$, $(0.60 \pm 0.18) \times 10^{-6}$, and $(0.75 \pm 0.17) \times 10^{-6} \text{ cm}^2 \text{ sec}^{-1}$ for 1200-, 960-, and 820- μ resin. A device was designed and constructed for contacting samples containing several beads to eliminate data scatter caused by variation in capacity of individual beads. The uranium self-diffusion coefficient in 1200- μ resin was determined to be $4.4 \times 10^{-8} \text{ cm}^2 \text{ sec}^{-1}$; the apparent uranium diffusion coefficients observed during nitrate and chloride elution were 1.8×10^{-7} and $2.38 \times 10^{-7} \text{ cm}^2 \text{ sec}^{-1}$, respectively. (auth)

25555 ORNL-2993(p.194-203)

Oak Ridge National Lab., Tenn.

CHEMICAL ENGINEERING RESEARCH.

A high-speed extraction contactor consisting of hydroclones stacked each above the other was developed to decrease organic-extractant holdup time and radiation-induced solvent degradation. In preliminary tests solvent contact times per theoretical stage were 10 to 50% of those in conventional contacting equipment. Stage efficiencies were 20 to 75%. Impedance matching of a mechanical pulser to a pulsed column by a resonant-transfer line and air cavity produced pulse volumes in the column 30% greater than those produced by the same mechanical pulser directly coupled to the load. The system was mathematically analyzed, and its performance was predicted by electrical analog computations. The steady-state transfer of uranyl nitrate across a quiescent interface between water and tri-n-butyl phosphate in kerosene was studied in an attempt to determine the limiting resistance to mass transfer in solvent-extraction operations. No resistance attributable to the interface per se was found, even when surface-active agents were present. In a fundamental study of thermal-diffusion separation of ionic species in liquids, Soret coefficients of CoSO_4 and CuSO_4 were measured as a function of temperature by a new technique reproducible to 1%. Transient pressures in the ventilating system of Building 3019 were calculated as a function of time in response to impulse and ramp-pressure perturbations in a 10,000-ft³ cell. For an impulse perturbation of +8.5 in. H_2O the cell would return to atmospheric pressure in 1.5 sec. A ramp perturbation of +3 in. H_2O per sec would raise the steady-state cell pressure from the design value of -1.5 in. H_2O to atmospheric pressure. (auth)

25556 ORNL-2993(p.209-16)

Oak Ridge National Lab., Tenn.

REACTOR EVALUATION STUDIES.

Fuel-material-selection studies indicated that the optimum fuel-cycle costs can be estimated for any set of conditions according to the following equation: optimum cycle cost (mills/kwhr) = $A + (B/\int k d\theta) + C [(\text{fabrication cost, } \$/\text{ft of fuel element})^{0.785} / (\int k d\theta)^\alpha]$ where A, B, C, and α are functions of the fuel uranium density; $\int k d\theta$ in fuel = average over the reactor ($\text{cal cm}^{-1} \text{ sec}^{-1}$), with k = fuel thermal conductivity, θ = temperature in excess of fuel-surface temperature, and the limits of integration are from the surface to the center of the fuel. The effect of diluent poisons in optimum fuel-cycle costs was also investigated as a function of fuel density and fabrication cost. The major problem in the shipment of spent fuels for the civilian power-reactor complex appears to be the dissipation of the fission-product decay heat. Preliminary studies indicated that problems associated with criticality and shielding are only secondary. (auth)

25557 TID-6424

Michigan Chemical Corp., St. Louis, Mich.

LIQUID-LIQUID EXTRACTION PROCESSES. Report 95. Period [covered]: April 9-18, 1957. C. W. Clemons. Aug. 13, 1957. Decl. Feb. 6, 1959. 10p. Project No. 942. OTS.

A review is made of the various means of effecting the separation of two or more substances by means of liquid-liquid extraction. Included is a discussion of the more common types of equipment used for effecting separations and also some of the more recent developments in new types of equipment. One section discusses the use of liquid-liquid extraction processes for the separation of the rare earths. (auth)

25558 TID-6430

Michigan Chemical Corp., St. Louis, Mich.

THE SEPARATION OF THE RARE EARTHS IN A LINDSEY

CONCENTRATE BY ION EXCHANGE. Report 74. Period covered: June 22, 1956 to March 30, 1957. Richard E. Witman. Apr. 2, 1957. Decl. Feb. 6, 1959. 19p. Project No. 926. OTS.

The ion-exchange separation of the rare earths was applied to Lindsey's yttrium concentrate. Passing the rare-earth solution through three band lengths gave 50% of the yttrium at a purity of 99% plus when charging about 3000 g of concentrate to a 6-in. ion-exchange-column system. Dysprosium and erbium were obtained in high purity from 4-in. columns by combining the heavys from several runs. Similarly, holmium, thulium, and ytterbium were obtained from 2-in. columns. Pure lutetium could not be obtained. (auth)

25559 USNRDL-TR-441

Naval Radiological Defense Lab., San Francisco.

QUANTITATIVE DISTILLATION OF FISSION RUTHENIUM. L. Wish. July 8, 1960. 11p.

The procedure for the distillation of fission ruthenium as the tetroxide has been modified to give a quantitative recovery without the use of ruthenium carrier. Four samples were analyzed for ruthenium with a precision of 2%. The activity of three of the samples agreed to 1%, but the fourth showed a 10% difference. The residue from the distillation could then be readily used for further fission-product separations. (auth)

25560 CEA-tr-A-687

LA SEPARATION DU NICKEL ET DU COBALT PAR EXTRACTION AU MOYEN DU T.B.P. (Separation of Nickel and Cobalt by Solvent Extraction with TBP). A. Musil and G. Weidmann. Translated into French from *Mikrochim. Acta*, No. 3, 476-80(1959). 9p.

It was found that cobalt can be extracted into tributylphosphate at acidities sufficient to produce a blue coloration. The distribution coefficients were determined for various concentrations, and a method is described for determining the cobalt colorimetrically. (T.R.H.)

25561 CEA-tr-X-196

SEPARATION DU TECHNETIUM PAR COPRECIPITATION OU PAR ÉCHANGE IONIQUE. (Separation of Technetium by Co-precipitation or Ion Exchange). Matsumura, Kojima, and Inoguchi. Translated into French by S. S. Minn from *Bunseki Kagaku* 7, 792(1958). 10p.

A study was made of the behavior of technetium in chemical analysis and in separation by coprecipitation and ion exchange. A KTcO_4 solution containing 116 mg/ml and with an activity of 2.33 mc/ml was diluted 1:100, and 0.1 ml was used for each test. The coprecipitation studies used copper sulfide, cadmium sulfide, arsenic sulfide, and iron hydroxide. The distribution coefficient on Dowex 1-X8 was measured. Some qualitative studies of radiocolloids were included. (T.R.H.)

25562 CEA-tr-X-212

SEPARATION ÉLECTROLYTIQUE DE L'YTTRIUM SANS ENTRAINEUR DANS LA SOLUTION AQUEUSE DE STRONTIUM-YTTRIUM. (Electrolytic Separation of Carrier-Free Yttrium from an Aqueous Strontium-Yttrium Solution). H. Hamaguchi, C. Ikeda, and T. Kawashima. Translated into French from *Bunseki Kagaku* 7, 243-6 (1958). 24p.

A method is given for electrolytic separation of carrier-free Y^{90} from neutral solutions with Sr^{90} . Its radiochemical purity reaches 99.9%. The method allows preparation of carrier-free Y^{90} in several minutes. After the pH of the Sr^{90} - Y^{90} solution has been adjusted to 5 or 6, it is electrolyzed at 2 to 6 volts with platinum electrodes. If necessary

the platinum electrode can be replaced by copper. A precipitate of Y^{90} forms only on the cathode. The precipitate is then dissolved in acid. One can use NH_4NO_3 , $(\text{NH}_4)_2\text{SO}_4$ or NH_4Cl interchangeably as electrolyte support. When the solution contains strontium carrier, only the sulfate should be used. (T.R.H.)

25563

COPRECIPITATION OF FISSION PRODUCTS ON FERRIC HYDROXIDE. Masayoshi Ishibashi, Tsunenobu Shigematsu, Takanobu Ishida, and Mutsuo Koyama. *Bull. Inst. Chem. Research, Kyoto Univ.* 38, 145-50(1960) May. (In English)

Coprecipitation of fission products with ferric hydroxide was studied. Two techniques for precipitation of the hydroxide were adopted; precipitation from homogeneous solution and a conventional one. Effects of pH of solutions were studied. Cations, such as alkali earths and rare earths, coprecipitate more with a precipitate obtained at a high pH than with one precipitated at a low pH. Ruthenium and anions behave conversely. It was concluded that the conventional precipitation process is more effective for the removal of fission products from a solution. The coprecipitation of mixed fission product, cooled for about 3 years, was above 80%. (auth)

25564

TRISOBUTYL PHOSPHATE AS EXTRACTANT FOR NITRATE AND PERCHLORATE. S. Niese (Zentralinstitut für Kernphysik, Rossendorf, Ger.). *Kernenergie* 3, 554-6 (1960) June. (In German)

The technical introduction of TiBP (triisobutyl phosphate) as extractant for $\text{UO}_2(\text{NO}_3)_2$ is related to certain difficulties, for which hints to avoid are given. For scientific research TiBP is better since the solvate is easily purified. The preparation and properties of solid solvates with uranyl, thorium, and cerium(IV) nitrates are described, and a statement on the state of uranyl perchlorates in TiBP is made. (tr-auth)

25565

PHYSICO-CHEMICAL ANALYSIS OF EXTRACTION PROCESSES. A. V. Nikolaev, A. G. Kurnakova, and I. I. Yakovlev. *Zhur. Neorg. Khim.* 5, 1832-9(1960) Aug. (In Russian)

Systematic studies were made of the diffusion diagrams of 8 aqueous isoconcentrates with HNO_3 (1.5 N) for salting out NH_4NO_3 - $\text{UO}_2(\text{NO}_3)_2$; $\text{Ca}(\text{NO}_3)_2$ - $\text{UO}_2(\text{NO}_3)_2$; $\text{Mg}(\text{NO}_3)_2$ - $\text{UO}_2(\text{NO}_3)_2$; $\text{Zn}(\text{NO}_3)_2$ - $\text{UO}_2(\text{NO}_3)_2$; $\text{Cu}(\text{NO}_3)_2$ - $\text{UO}_2(\text{NO}_3)_2$; $\text{Cu}(\text{NO}_3)_2$ - $\text{Th}(\text{NO}_3)_4$; $\text{Fe}(\text{NO}_3)_3$ - $\text{Th}(\text{NO}_3)_4$, and $\text{Al}(\text{NO}_3)_3$ - $\text{Th}(\text{NO}_3)_4$. The densities of the systems $\text{UO}_2(\text{NO}_3)_2$ - NH_4NO_3 - H_2O - $(\text{C}_2\text{H}_5)_2\text{O}$ and $\text{UO}_2(\text{NO}_3)_2$ - NH_4NO_3 - H_2O - $(\text{C}_2\text{H}_5)_2\text{O}$ - HNO_3 were determined. (R.V.J.)

25566

EXTRACTION OF URANYL NITRATE BY DIISOAMYL ETHER OF METHYLPHOSPHONIC ACID. A. S. Solovkin, M. I. Konarev, and D. P. Adaev. *Zhur. Neorg. Khim.* 5, 1861-7(1960) Aug. (In Russian)

The contents of complex compounds formed in the organic phase during uranyl nitrate extraction by diisoamyl ester of methyl phosphonic acid (DAMPA) and ester solutions in weakly polar organic diluents were investigated. The properties of uranyl nitrate saturated DAMPA solutions were also investigated. Two complex compounds $\text{UO}_2(\text{NO}_3)_2 \cdot \text{DAMPA}$ disolvate and $\text{UO}_2(\text{NO}_3)_2 \cdot \text{DAMPA}$ monosolvate were found to be present in the form of non-dissociated monomers. Reversible photochemical reduction of U(VI) to U(IV) was evident in undiluted DAMPA and in DAMPA CCl_4 solutions. The formation of a third phase in DAMPA kerosene solutions in concentrated nitric acid solutions was observed. The disolvate dipole

moment was 3.5 ± 0.02 Debye units. The ratio of uranyl nitrate specific viscosity in DAMPA and in tributylphosphate (TBP) to the molal uranium concentration in pure solvent is constant for a given extractor. (R.V.J.)

25567

EXTRACTION OF HAFNIUM BY TRIBUTYL PHOSPHATE. S. S. Korovin, E. N. Gribennik, and L. N. Komissarova (Moscow Inst. of Fine Chemical Tech.). *Zhur. Neorg. Khim.* **5**, 1876-81(1960) Aug. (In Russian)

The distribution of macroquantities of hafnium and zirconium in nitric acid and tributylphosphate was studied. Extraction of hafnium is achieved with nitric acid concentration above 6 N; a high extraction of hafnium takes place at nitric acid concentrations over 9 N; the coefficient of hafnium distribution is slightly smaller than that of zirconium. Extraction of acid solutions of zirconium and hafnium at room temperature permits hydrolysis and polymerization, producing multi-complexes. An analysis was made of hafnium distribution as a function of concentration in solutions with 5.1 to 6.1 N acidity. (R.V.J.)

25568

TRI-N-OCTYLAMINE EXTRACTION OF PLUTONIUM IN HYDROCHLORIC ACID. V. B. Shevchenko, V. S. Shmidt, and E. A. Mezov. *Zhur. Neorg. Khim.* **5**, 1911-13(1960) Aug. (In Russian)

The mechanism of plutonium(IV) and (III) complexing by tri-n-octylamine in hydrochloric acid was studied. Plutonium(IV) is easily extracted from hydrochloric acid by tri-n-octyl ammonium chloride; the separated plutonium transforms into plutonium(IV) chloride with 2 molecules TOA · HCl. Plutonium(III) is not quantitatively separated by tri-n-octyl ammonium solutions. (R.V.J.)

25569

IMPROVEMENTS IN OR RELATING TO PROCESS FOR TREATING NUCLEAR FUEL. John Kieth Dawson, Allan Robert Gibson, and Herbert Alan McKay (to United Kingdom Atomic Energy Authority). British Patent 838,508. June 22, 1960.

A method for recovering the fissile material (plutonium or uranium) from irradiated reactor fuel for subsequent reuse is given whereby a large proportion of fission products is removed from the fissile material. The method consists of adding the fuel metal to a melt of PbCl_2 and an alkali chloride (to lower the m. p.) until all the lead is displaced, separating the melt from the lead, adding aluminum until all the fissile material is displaced, and separating the fissile material-aluminum alloy from the AlCl_3 melt. If aluminum is added in excess, the fission products that followed the fissile material into the PbCl_2 melt may be displaced by aluminum owing to the tendency of rare earths to alloy with aluminum. These fission products may be volatilized from the metal by heating to 1200°C . (D.L.C.)

25570

SEPARATION OF PLUTONIUM. (to United Kingdom Atomic Energy Authority). British Patent 843,481. Aug. 4, 1960.

A method for the separation of plutonium from solutions of irradiated uranium by LaF_3 carrier is given. At the same time, the formation and settling rate of the carrier are improved by coprecipitation of PbSO_4 . This method will improve any type of LaF_3 precipitate, but it flocculates preformed LaF_3 better than coformed LaF_3 . (Preformed LaF_3 is prepared by first adding F^- to the solution and then La^{3+} .) Four examples of the application of this method are given. Plots of precipitate volume vs. settling time are compared for preformed LaF_3 - PbSO_4 , preformed LaF_3 , and coformed LaF_3 . (D.L.C.)

25571

PROCESS FOR THE RECOVERY OF URANIUM. (to Comptoir des Phosphates de l'Afrique du Nord). British Patent 846,360. Aug. 31, 1960.

The process for uranium recovery from slag obtained from furnaces used in the manufacture of phosphorus can be facilitated by first separating calcium from the slag. This can be done in the following manner: acid is added to the slag in several steps, the dissolution of calcium is allowed to proceed for at least 1 hr at 70 to 80°C , and the insoluble fraction containing the uranium is filtered off and washed with water. The solid is then treated for uranium recovery by the usual means, e.g., H_2SO_4 attack or Na_2CO_3 extraction. In order to obtain maximum possible uranium retention in the solid and dissolution of $>90\%$ of slag calcium, the slag should contain $>1\%$ P_2O_5 and a few % ($\text{Fe}_2\text{O}_3 + \text{Al}_2\text{O}_3$); if the slag is deficient in P_2O_5 and rich in iron and aluminum, a quantity of H_3PO_4 should be added to the attacking acid. The acid can be HCl , HNO_3 , HClO_4 , or H_3PO_4 , and should be 5 to 6 N in concentration. H_2SO_4 cannot be used because it complexes uranium. Three applications of the method are given using slags from mineral phosphates. (D.L.C.)

25572

IMPROVED ANION-EXCHANGE PROCESS FOR URANIUM RECOVERY. John Aveston, David Anthony Everest, and Gordon Henry Elliot Sims (to United Kingdom Atomic Energy Authority). British Patent 848,132. Sept. 14, 1960.

Anion-exchange materials for uranium recovery can be prepared in tubular form by amination of vinyl chloride polymer tubing so that $>1\%$ of the combined chlorine atoms are replaced with basic nitrogen-containing groups. In operation, the uranium solution is made to flow turbulently through the tube, and this method of uranium recovery is of value for pulpy solutions which can be pumped through the tube at a rate fast enough to keep the particles in suspension. Little mechanical loss, i.e., attrition, occurs. An example of the amination of polyvinyl chloride tubing and its use in uranium recovery from a H_2SO_4 leach pulp of an ore is given. (D.L.C.)

25573

CONCENTRATION PROCESS FOR PLUTONIUM IONS, IN AN OXIDATION STATE NOT GREATER THAN +4, IN AQUEOUS ACID SOLUTION. G. T. Seaborg and S. G. Thompson (to U. S. Atomic Energy Commission). U. S. Patent 2,940,819. June 14, 1960.

A process for concentrating plutonium is given in which plutonium is first precipitated with bismuth phosphate and then, after redissolution, precipitated with a different carrier such as lanthanum fluoride, uranium acetate, bismuth hydroxide, or niobic oxide.

25574

ADSORPTION-BISMUTH PHOSPHATE METHOD FOR SEPARATING PLUTONIUM. E. R. Russell, A. W. Adamson, and G. E. Boyd (to U. S. Atomic Energy Commission). U. S. Patent 2,942,937. June 28, 1960.

A process is given for separating plutonium from uranium and fission products. Plutonium and uranium are adsorbed by a cation exchange resin, plutonium is eluted from the adsorbent, and then, after oxidation to the hexavalent state, the plutonium is contacted with a bismuth phosphate carrier precipitate.

25575

SEPARATION OF PLUTONIUM VALUES FROM OTHER METAL VALUES IN AQUEOUS SOLUTIONS BY SELECTIVE COMPLEXING AND ADSORPTION. R. H. Beaton (to

U. S. Atomic Energy Commission). U. S. Patent 2,942,939. June 28, 1960.

A process is given for separating tri- or tetravalent plutonium from fission products in an aqueous solution by complexing the fission products with oxalate, tannate, citrate, or tartrate anions at a pH value of at least 2.4 (preferably between 2.4 and 4), and contacting a cation exchange resin with the solution whereby the plutonium is adsorbed while the complexed fission products remain in solution.

25576

PROCESS FOR SEPARATING IODINE-132 FROM FISSION PRODUCTS. M. W. Greene, W. D. Tucker, and G. Samos (to U. S. Atomic Energy Commission). U. S. Patent 2,942,943. June 28, 1960.

A process is given for isolating I^{132} in substantially pure form. Te^{132} , which is the radioactive parent of I^{132} , is adsorbed on a finely divided mass of a chromatographic grade of refractory metal oxide, i.e., alumina, zirconia, titania, and ceria. After a period of time is allowed for the Te^{132} to decay, a 0.001 to 0.01 molar solution of ammonium hydroxide is passed over the finely divided oxides and the I^{132} values are eluted.

25577

METHOD OF SEPARATING URANIUM FROM ALLOYS. P. Chiotti and H. E. Shoemaker (to U. S. Atomic Energy Commission). U. S. Patent 2,942,968. June 28, 1960.

Uranium can be recovered from metallic uranium-thorium mixtures containing uranium in comparatively small amounts. The method of recovery comprises adding a quantity of magnesium to a mass to obtain a content of from 48 to 85% by weight; melting and forming a magnesium-thorium alloy at a temperature of between 585 and 800°C; agitating the mixture, allowing the mixture to settle whereby two phases, a thorium-containing magnesium-rich liquid phase and a solid uranium-rich phase, are formed; and separating the two phases.

25578

RUTHENIUM DECONTAMINATION METHOD. A. T. Gresky (to U. S. Atomic Energy Commission). U. S. Patent 2,945,740. July 19, 1960.

A liquid-liquid extraction method of separating uranium from fission products is given. A small amount of a low molecular weight ketone is added to an acidic aqueous solution containing neutron-irradiated uranium and its associated fission products. The resulting solution is digested and then contacted with an organic liquid that extracts uranium values. The purpose of the step of digesting the aqueous solution in the presence of the ketone is to suppress the extractability of ruthenium.

25579

PREPARATION OF ALKYL PYROPHOSPHATE EXTRACTANTS. C. A. Levine, W. E. Skiens, and G. R. Moore (to U. S. Atomic Energy Commission). U. S. Patent 2,947,774. Aug. 2, 1960.

A process for providing superior solvent extractants for metal recovery processes is given wherein the extractant comprises an alkyl pyrophosphoric acid ester dissolved in an organic solvent diluent. Finely divided solid P_2O_5 is slurried in an organic solvent-diluent selected from organic solvents such as kerosene, benzene, chlorobenzene, toluene, etc. An alcohol selected from the higher alcohols having 4 to 17 carbon atoms, e.g., hexanol-1, heptanol-3, octanol-1, 2,6-dimethyl-heptanol-4, and decanol-1, is rapidly added to the P_2O_5 slurry in the amount of about 2 moles of alcohol to 1 mole of P_2O_5 . The temperature is maintained below about 110°C during the course of the

P_2O_5 -alcohol reaction. An alkyl pyrophosphate extractant compound is formed as a consequence of the reaction process. The alkyl pyrophosphate solvent-diluent extractant phase is useful in solvent extraction metal recovery processes.

25580

FUSED SALT PROCESS FOR RECOVERY OF VALUES FROM USED NUCLEAR REACTOR FUELS. R. H. Moore (to U. S. Atomic Energy Commission). U. S. Patent 2,948,586. Aug. 9, 1960.

A process is given for recovering plutonium from a neutron-irradiated uranium mass (oxide or alloy) by dissolving the mass in an about equimolar alkali metal-aluminum double chloride, adding aluminum metal to the mixture obtained at a temperature of between 260 and 800°C, and separating a uranium-containing metal phase and a plutonium-chloride- and fission-product chloride-containing salt phase. Dissolution can be expedited by passing carbon tetrachloride vapors through the double salt. Separation without reduction of plutonium from neutron-bombarded uranium and that of cerium from uranium are also discussed.

25581

METHOD FOR SEPARATION OF PLUTONIUM FROM URANIUM AND FISSION PRODUCTS BY SOLVENT EXTRACTION. G. T. Seaborg, W. J. Blaedel, and M. T. Walling, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,950,166. Aug. 23, 1960.

A process is given for separating from each other uranium, plutonium, and fission products in an aqueous nitric acid solution by the so-called Redox process. The plutonium is first oxidized to the hexavalent state, e.g., with a water-soluble dichromate or sodium bismuthate, preferably together with a holding oxidant such as potassium bromate, potassium permanganate, or an excess of the oxidizing agent. The solution is then contacted with a water-immiscible organic solvent, preferably hexone, whereby uranium and plutonium are extracted while the fission products remain in the aqueous solution. The separated organic phase is then contacted with an aqueous solution of a reducing agent, with or without a holding reductant (e.g., with a ferrous salt plus hydrazine or with ferrous sulfamate), whereby plutonium is reduced to the trivalent state and back-extracted into the aqueous solution. The uranium may finally be back-extracted from the organic solvent (e.g., with a 0.1 N nitric acid).

25582

CONCENTRATION AND DECONTAMINATION OF SOLUTIONS CONTAINING PLUTONIUM VALUES BY BISMUTH PHOSPHATE CARRIER PRECIPITATION METHODS. G. T. Seaborg and S. G. Thompson (to U. S. Atomic Energy Commission). U. S. Patent 2,950,168. Aug. 23, 1960.

A process is given for isolating plutonium present in the tetravalent state in an aqueous solution together with fission products. First, the plutonium and fission products are coprecipitated on a bismuth phosphate carrier. The precipitate obtained is dissolved, and the plutonium in the solution is oxidized to the hexavalent state (with ceric nitrate, potassium dichromate, Pb_2O_4 , sodium bismuthate and/or potassium dichromate). Thereafter a carrier for fission products is added (bismuth phosphate, lanthanum fluoride, ceric phosphate, bismuth oxalate, thorium iodate, or thorium oxalate), and the fission-product precipitation can be repeated with one other of these carriers. After removal of the fission-product-containing precipitate or precipitates, the plutonium in the supernatant is reduced to the tetravalent state (with sulfur dioxide, hydrogen per-

oxide, or sodium nitrate), and a carrier for tetravalent plutonium is added (lanthanum fluoride, lanthanum hydroxide, lanthanum phosphate, ceric phosphate, thorium iodate, thorium oxalate, bismuth oxalate, or niobium pentoxide). The plutonium-containing precipitate is then dissolved in a relatively small volume of liquid so as to obtain a concentrated solution. Prior to dissolution, the bismuth phosphate precipitates first formed can be metathesized with a mixture of sodium hydroxide and potassium carbonate and plutonium-containing lanthanum fluorides with alkali-metal hydroxide. In the solutions formed from a plutonium-containing lanthanum fluoride carrier the plutonium can be selectively precipitated with a peroxide after the pH was adjusted preferably to a value of between 1 and 2. Various combinations of second, third, and fourth carriers are discussed.

ENGINEERING AND EQUIPMENT

General and Miscellaneous

25583 APEX-569

General Electric Co. General Engineering Lab., Schenectady, N. Y.

INVESTIGATION OF SOLID FILM LUBRICANTS AND SLIDING CONTACTS AT TEMPERATURES ABOVE 1000°F. M. B. Peterson. Feb. 1958. 63p. For General Electric Co. Aircraft Nuclear Propulsion Dept. Contract AF33(600)-38062 and AT(11-1)-171. OTS.

Materials for use as solid lubricants and the sliding characteristics of materials were evaluated at 1000 to 1800°F. When used as solid-film lubricants, Cu_2O , MoO_3 , NiMoO_4 , Co_3O_4 , and WO_3 lowered friction and prevented surface damage at 1300°F. The transition from surface slip through solid-film lubrication was studied by use of surface films of known physical properties. A porous $\text{ZnO} \cdot \text{SiO}_2$ impregnated with PbO exhibited low wear at 1300°F. Wear-time curves were obtained at 1300°F with various metals and ceramic-type materials sliding against R-235. (C.J.G.)

25584 BAW-90-1

Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.

CHECK VALVE WATER HAMMER CHARACTERISTICS.

S. H. Esleeck and R. M. Rosser. Nov. 1959. 43p.

A method is developed for predicting water hammer in any system, provided the rates of forward-flow deceleration and back-flow acceleration are known. Check-valve disc weight, disc inertia, reaction between water and disc, body configurations, disc shape, and mechanical aids to closure are considered. Correlation between the method and experimental results was very good, deviations being within 10%. (C.J.G.)

25585 HW-58220(Rev.)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

OPERATING MANUAL FOR 105-C METAL EXAMINATION FACILITY. J. M. Fouts. May 16, 1960. 58p. Contract AT(45-1)-1350. OTS.

Equipment is described for the 105 Metal Examination Facility (MEF). The 105 MEF consists of four water-filled basins and a decontamination area. Operating instructions are given for the slug breaker, ultrasonic test equipment, de jacketing equipment, microscope, camera, weigher, cleaner, etc. (W.L.H.)

25586 IS-188

Ames Lab., Ames, Iowa.

PERFORMANCE CHARACTERISTICS OF AN ELECTROMAGNETIC PUMP. David H. Thompson and Ray W. Fisher. Aug. 1960. 55p. Contract W-7405-eng-82. OTS.

The performance characteristics of small linear-induction electromagnetic pumps suitable for high-temperature liquid-metal test-loop operation were examined. Also, methods by which the performance of such pumps may be improved were investigated. The phenomenon of fluid wetting of the pump duct wall and the use of side bars provide powerful tools for improving the linear-induction-pump performance characteristics. Full advantage of the improved performance can be obtained if the hydraulic losses are minimized by using a pump section with large duct width, which also improves the power factor and decreases the phase current requirements of the pump. (auth)

25587 NP-9188

Lehigh Univ., Bethlehem, Penna. Inst. of Research.

BASIC FACTORS IN THE FORMATION AND STABILITY OF NON-SOAP LUBRICATING GREASES. Quarterly Progress Report No. 1 for April 1, 1960 to July 1, 1960. John J. Chessick, Albert C. Zettlemoyer, James P. Wightman, Lovella M. Raub, and Edward Borger. July 1960. 12p. Contract AF33(616)-7120.

Monthly Report No. 3 is incorporated with this report and will not be issued separately.

Preliminary evaluation of MoS_2 as a potential solid in a paraffin oil grease revealed good thermal stability at 600°F. The preparation of high-area MoS_2 is described. The fluidizing ability of the n-heptyl compounds on gels consisting of polar thickeners in grease vehicles was determined. The n-heptyl chloride exhibited no fluidizing ability; n-heptylamine and n-heptyl alcohol, which gave evidence of marked breakdown of gel structure, exhibited good fluidizing ability. The additive behavior of n-heptanoic acid and n-heptaldehyde was intermediate. Measurements on sedimentation volumes supported the above penetration measurements. The solubility of water in the n-heptyl compounds paralleled the sedimentation volume results. In continuing efforts to reduce the free energy of silica surfaces by incorporation of inorganic compounds into the surface of this material, studies were concentrated on using high temperatures so that surface-ion mobility is sufficient to permit penetration of at least a monolayer of the substance to be incorporated into the surface. High temperature (500 to 850°C) incorporations of HgI_2 were unsuccessful due to decomposition of HgI_2 or sintering of the sample. Surface incorporation of HgI_2 was successful to some extent at 300°C. (See also WADC-TR-55-240(Pt.VI).) (C.J.G.)

25588 NRL-5474

Naval Research Lab., Washington, D. C.

THE STABILIZATION OF SILICONE LUBRICATING LIQUIDS ABOVE 200°C. PART 2. IRON, COPPER, CERUM, AND OTHER METAL COMPOUNDS. H. R. Baker and C. R. Singleterry. Mar. 1, 1960. 29p. Part 1 issued as NRL-5457.

Silicone liquids have been stabilized against oxidation and gelation so that the useful life at 325°C or below is lengthened 30- to 500-fold over the original oil. The stabilization is accomplished by treating the silicone oil with a cerium soap in the presence of disalicylalpropylenediamine, or a related chelating compound, at 285°C. Similar but less effective stabilization occurs when the cerium soap is replaced by suitable iron, copper, chromium, praseodymium, or europium compounds. This treatment is effective with dimethyl silicones and also

with phenyl-substituted types. The percentage improvement obtainable with the phenylated oils decreases with increasing aromatic content; after inhibition the lightly phenylated oils, which have excellent viscosity-temperature characteristics, have as long a life as the highly phenylated oils, heretofore found most stable in high-temperature service. Also, the volatile products of silicone oxidation at 300°C promote premature gelation if they are returned to the liquid under test. The inhibiting procedure described does not appreciably alter the lubricity or the temperature at which thermal decomposition becomes the important mechanism of silicone degradation. The viscosity is slightly increased but the viscosity-temperature coefficient is not impaired. The inhibited oil gives promise of special usefulness for applications in which the lubricant is exposed to air at high temperature in thin films or in which premature gelation is a serious problem. (auth)

25589 S/TD-1735(Vol.I)

Sundstrand Turbo. Div. of Sundstrand Corp., Rockford, Ill.

STUDY OF TURBINE AND TURBOPUMP DESIGN PARAMETERS. VOLUME I. A STUDY OF HIGH PRESSURE RATIO RE-ENTRY TURBINES. Final Report for Period February 1, 1958-January 30, 1960. Hans D. Linhardt. Jan. 30, 1960. 152p. Contract Nonr-2292(00).

The design point analysis of two-stage, axial re-entry type turbines is presented for the case of low weight flow and high over-all pressure ratios. The optimum pressure split between both stages is investigated approximately by evaluating the optimum performance for two-stage re-entry turbines with equal heads or equal pressure ratios in both stages. The optimum efficiency for both pressure splits is analyzed and a theoretical method of determining the detailed design criteria is presented for each optimum design. The method of analysis is substantiated by test of a two-stage re-entry turbine designed according to the analysis. Deviations from this analysis were found to be caused by increased leakage and off-design performance of the second-stage nozzle. (auth)

25590 S/TD-1735(Vol.II)

Sundstrand Turbo. Div. of Sundstrand Corp., Rockford, Ill. STUDY OF TURBINE AND TURBOPUMP DESIGN PARAMETERS. VOLUME II. A STUDY OF HIGH PRESSURE DRAG TURBINES USING COMPRESSIBLE FLUIDS. Final Report for Period February 1, 1958 through January 30, 1960. Robert Spies. 61p. Contract NONR-2292(00). (AD-232636).

A program for study of large-pressure-ratio drag turbines using compressible fluids and verification of a simplified drag-turbine theory is discussed. The simplified theory presented by Balje (*Trans. ASME*, Aug. '57) was extended to cover the case of a compressible gas in a turbine of arbitrary area distribution. Conclusions were verified regarding superior performance when an expanding channel is used, and areas of future investigations were indicated. The attainable efficiency of large-pressure-ratio drag turbines is high with values of 44% anticipated. (auth)

25591 S/TD-1735(Vol.III)

Sundstrand Turbo. Div. of Sundstrand Corp., Rockford, Ill. STUDY OF TURBINE AND TURBOPUMP DESIGN PARAMETERS. VOLUME III. LOW SPECIFIC SPEED TURBINES BASED ON TANGENTIAL FLOW THEORY. Final Report for Period February 1, 1958-January 30, 1960. Michael Dubey. Jan. 30, 1960. 106p. Contract Nonr-2292(00). (AD-232637).

A proposed tangential-flow theory for drag turbines stipulates that a recirculating-flow mechanism for har-

nessing the energies available in a working fluid can be expressed by Euler's equations, with minor corrections for friction forces. The theory suggests that a flow pattern much like a corkscrew can be established and maintained by the channel geometry and block seals which satisfy the boundary conditions of the theoretical equations. Although the vaneless peripheral channel is analogous to the drag turbine, the actual flow can be visualized more easily as that of a reentry impulse turbine with the streamlines within the channel forming the necessary reentry duct. The significant equations of the flow theory are used to design a test turbine which successfully demonstrates that the desired flow pattern can be established. The corresponding high efficiencies predicted by the analysis are also attained. These turbine efficiencies are considerably higher than that possible for single-stage axial flow, terry, or drag turbines operating at the same very low specific speeds. By using the loss coefficients inferred by the test data, an N_D diagram is derived indicating the maximum efficiencies attainable with optimized design parameters. The effects of geometry ratios on performance are also discussed. (auth)

25592 S/TD-1735(Vol. IV)

Sundstrand Turbo. Div. of Sundstrand Corp., Rockford, Ill. STUDY OF TURBINE AND TURBOPUMP DESIGN PARAMETERS. VOLUME IV. LOW SPECIFIC SPEED TURBOPUMP STUDY. Final Report for Period October 6, 1958 through October 31, 1959. Nov. 20, 1959. 239p. Contract NONR-2292(00). (AD-232638).

An investigation of maximum efficiencies of low-specific-speed turbopumps obtainable with the present state of technology is discussed. Optimum suction-specific speed and optimum efficiency are analyzed, and a theoretical method of determining the detailed design criteria for each optimum design is performed. Experimental evidence was accumulated to substantiate the analysis, and the final design parameters are presented as functions of pump specific speed and specific diameter. (auth)

25593 UCRL-6014

California. Univ., Livermore. Lawrence Radiation Lab. OPTIMIZATION OF MOLECULAR FLOW CONDUCTANCE. Leonard L. Levenson, Norman Milleron, and Donald H. Davis. Aug. 1960. 25p. Contract W-7405-eng-48. OTS.

A method is described for measuring the molecular flow conductance of scale models of complete diffusion pump systems. Results are given in terms of Clausing's factor P , defined by $P = F/F_0$, where F is the net volume flow rate through a geometry and F_0 is the volume flow rate of gas striking the orifice of the geometry. Use of the factor P allows prediction of the conductance of the full-scale system represented by the model. Experimental and theoretical data are presented for straight cylinders, cylindrical elbows, and several geometries having no line of sight through them. It is shown that for an optimized diffusion-pump system, comprising baffle, trap, and valve, $0.3 < P < 0.5$ can be obtained. (auth)

25594 JPRS-5423

THERMODYNAMIC SCALE OF HIGH PRESSURES UP TO 25,000 kgf/cm². (Termodinamicheskaya Shkala Vysokikh Davlenii do 25000 kgs/cm²). M. K. Zhokhovskii (Zhokhovskiy), V. N. Razumikhin, E. V. Zolotykh, and L. L. Burova. Translated from *Izmeritel'naya Tekh.* No. 11, 26-9(1960). 14p. OTS.

A thermodynamic pressure scale, based on the equation of a mercury fusion curve, was extended to 25,000 kgf/cm² with a degree of reliability of $\pm 0.5\%$. A group of model resistance manometers was created, which, within the indicated ranges and with the above-mentioned degree of reli-

bility, reproduce the thermodynamic pressure scale. An installation was devised by means of which pressure scale values may be communicated to any desired mechanical high-pressure instrument. (W.L.H.)

25595 UCRL-Trans-501(L)

AN INVESTIGATION OF SALT CARRY OFF BY STEAM USING RADIOACTIVE ISOTOPES. A. A. Andreevskii and Yu. V. Zenkevich. Translated by Esther S. Goldberg from *Teploenergetika* 2, No. 9, 37-42(1955). 18p. (Includes original, 6p.). JCL or LC.

It is established that salt carry-off takes place in pre-critical regions because the character of the carry-off is determined by the degree of moisture separation from the steam both in the steam region itself and in the outlet pipes. During effective separation the dependence of carry-off on load is practically absent. During weak separation the dependence of carry-off on load is found to be very significant. The carry-off of salts by steam in the so-called precritical region, in which boilers usually operate, was studied very little. A consideration of the nature of capillary carry-off indicates the necessity for investigating this field with far more accurate methods to determine the salt content of the steam, particularly with radioactive isotope methods. (auth)

25596

PUMPING CHARACTERISTICS OF A TITANIUM DROPLET GETTER-ION PUMP. L. Holland and L. Laurensen (Edwards High Vacuum Ltd., Crawley, Sussex, Eng.). *Brit. J. Appl. Phys.* 11, 401-7(1960) Sept.

The performance of a 12-in. diameter titanium getter-ion pump with an evaporated getter area of 3400 cm² was studied. The titanium was evaporated from an electron-bombarded molten bead suspended via a frozen zone from a cooled anode. A triode electrode system was used for ionization pumping. The sorption rates of a number of gases were measured in the pressure range 10⁻⁴ to 10⁻⁸ mm of mercury. The pumping speed for nitrogen was enhanced by operating the ionization source during evaporation. The high tension voltage used with the vapor source influenced the form of the titanium bead, and at low voltages (~800 v) and high-power inputs (~465 w) large metal droplets were obtained giving the highest evaporation and sorption rates. Sorption rates were greatly increased if a diffusion pump was in operation during gettering, because impurity gases slowly sorbed by the getter-ion pump were more effectively removed. Pumping speeds in liters/sec at 10⁻⁶ mm of mercury for the getter-ion pump with a diffusion pump (10 liters/sec) in operation and a titanium evaporation rate of 40 mg/min were as follows: oxygen₂, 2450; nitrogen₂, 4500; hydrogen₂, 1600; air, 600; argon, 2.6; and calor gas, 90. The low pumping speed of air was due to the low sorption rate of the argon component. Hydrocarbon gases were slowly sorbed and when mixed with active gases greatly reduced their pumping speed. The pump-down characteristics of the getter-ion pump were examined and it was found that the ultimate pressure was only slowly regained after exhausting oxygen. The sorption efficiency can be found from the equation: $S_m = \alpha S_0$, where S_m is the measured sorption rate per unit getter area (liters/sec/cm²), S_0 is the ideal sorption rate and α the sorption coefficient. Values of α measured at 10⁻⁶ mm of mercury were as follows: oxygen₂, 0.068; nitrogen₂, 0.12; and hydrogen₂, 0.012; possible reasons for the low value of α for hydrogen are considered. (auth)

25597

A CENTRATION SYSTEM FOR ROTATION APPARATUSES WITH A CONSTANT FOCAL DISTANCE, WHOSE SOURCE

OF IRRADIATION IS ROTATED AROUND THE PATIENT. V. I. Bulatov, L. M. Krichevskii, A. F. Rimman, and A. Z. Shvartsman. *Vestnik Rentgenol. i Radiol.* 35, No. 3, 56-7 (1960) May-June. (In Russian)

A device with a constant focal distance that rotates around a patient was designed and a simple scheme is suggested for checking the diaphragm. The device consists of a fluorescence screen which turns 360° about an axis which coincides with that of the apparatus. The manually controlled screen enables observations at all points of the circumference. (R.V.J.)

25598

IMPROVEMENTS IN THERMAL INSULATION. Walter George Marskell and Duncan McNaughton (to Babcock and Wilcox, Ltd.). British Patent 846,977. Sept. 7, 1960.

Thermal insulation suitable for use on the internal surfaces of reactor pressure vessels may be made in the form of a hollow metal casing with the space between opposite faces divided into partitions containing heat- and radiation-resistant inert bodies. The metal may be stainless steel, and the bodies may be granular graphite. Such casings may be used in gas-cooled graphite-moderated reactors. The problem of insulating a control nozzle in such a reactor is treated. (D.L.C.)

25599

IMPROVEMENTS IN AND RELATING TO TUBULAR HEAT EXCHANGERS. Andre Huet. British Patent 847,005. Sept. 7, 1960.

An improved vaporizer tube design is given which comprises a heat-exchange element having three coaxial tubes providing two fluid passages through the element, with one of the coaxial tubes either deformed helically or formed with circular corrugations in its walls. The advantages of such a vaporizer tube are that the exchange surface between the two fluids is increased; the corrugated walls are flushed, thereby destroying adhering films; and the separation of the water and steam is facilitated. (D.L.C.)

25600

IMPROVEMENTS IN OR RELATING TO EQUIPMENT FOR THE HANDLING, PROCESSING OR TREATMENT OF DANGEROUS SUBSTANCES. John Robert Vernon Dolphin (to United Kingdom Atomic Energy Authority). British Patent 847,363. Sept. 7, 1960.

Improved equipment for handling and treating radioactive and/or toxic substances is described which comprised a circular chamber formed by a domed double-skinned covering, the space between the skins being maintained at low pressure, and having a window and associated glove ports. Within the chamber, there is a rotary table actuated by a motor so that it is moved into position for manipulations on its surface. The chamber also has an air-tight door with an air lock for servicing the equipment from the inside. The advantages of such a chamber over a series of conventional chambers are given. (D.L.C.)

25601

IMPROVEMENTS IN OR RELATING TO ELECTROMAGNETIC INTERACTION PUMPS SUITABLE FOR LIQUID METALS. Dudley Albert Watt (to United Kingdom Atomic Energy Authority). British Patent 847,492. Sept. 7, 1960.

An electromagnetic interaction pump for pumping liquid metals, single-phase conduction type incorporating a transformer, is designed for producing high pressures and comprises closed and air-gap iron circuits with a duct in the gap for the liquid metal. The flux in the gap may be further increased by an auxiliary winding on the air-gap iron circuit. (D.L.C.)

25602

IMPROVEMENTS IN OR RELATING TO ELECTRICALLY

DRIVEN ROTARY APPARATUS. Allan Barker (to United Kingdom Atomic Energy Authority). British Patent 847,634. Sept. 14, 1960.

An electrically driven centrifugal compressor for hot gases is designed comprising a casing containing four journal bearings which support two hollow shafts coupled together by another hollow shaft. The bearings are supported by flexible diaphragms, and the electric stator windings are inside the casing and not isolated from the gas in the impeller, thus eliminating the barrier between stator and rotor such as that in "canned rotor" pumps. The bearings and hollow shafts can be operated in the gas-lubricated state. The compressor is designed to circulate H_2 at 300°C and an inlet pressure of 150 psi in a loop circuit. (D.L.C.)

25603

NEEDLE VALVES. Alan Grange and Leslie William Owen (to United Kingdom Atomic Energy Authority). British Patent 848,261. Sept. 14, 1960.

A needle valve for accurately controlling the flow of gases and liquids for long periods of time is designed. It can operate with high-vacuum equipment. The valve comprises a body enclosing a movable needle and a floating seat provided with a stop member that restricts needle movement when in contact with the seat so as to prevent excessive needle pressure on the seat. (D.L.C.)

25604

CRANE POSITIONING APPARATUS. F. W. Landsiedel and H. Wolff (to U. S. Atomic Energy Commission). U. S. Patent 2,942,736. June 28, 1960.

An apparatus is described for automatically accomplishing the final accurate horizontal positioning of a crane after the latter has been placed to within $\frac{1}{8}$ in. of its selected position. For this purpose there is provided a tiltable member on the crane mast for lowering into contact with a stationary probe. Misalignment of the tiltable member, with respect to the probe as the member is lowered, causes tilting of the latter to actuate appropriate switches that energize motors for bringing the mast into proper position. When properly aligned the member is not tilted and a central switch is actuated to indicate the final alignment of the crane.

25605

MEANS AND METHOD FOR PRODUCING A VACUUM. M. A. Otavka (to U. S. Atomic Energy Commission). U. S. Patent 2,947,465. Aug. 2, 1960.

A new method is given for starting the operation of evapor-ion vacuum pumps. Ordinarily this type of pump is started by inducing an electric field with the vacuum chamber; however, by placing such an electric field in the chamber at the outset, a glow discharge may be initiated which is harmful to the pump. The procedure consists of using a negative electric field during which time only gettering action takes place; subsequently when the field reverses after a sufficient reduction of the number of gaseous particles in the chamber both gettering and ionizing takes place.

25606

CENTRIFUGE END CAP. J. W. Beams and L. B. Snoddy (to U. S. Atomic Energy Commission). U. S. Patent 2,947,471. Aug. 2, 1960.

An end cap for ultra-gas centrifuges is designed to impart or remove angular momentum to or from the gas and to bring the entering gas to the temperature of the gas inside the centrifuge. The end cap is provided with slots or fins for adjusting the temperature and the angular momentum of the entering gas to the temperature and momentum

of the gas in the centrifuge and is constructed to introduce both the inner and the peripheral stream into the centrifuge.

25607

CENTRIFUGE APPARATUS. C. Skarstrom, H. C. Urey, and K. Cohen (to U. S. Atomic Energy Commission). U. S. Patent 2,947,472. Aug. 2, 1960.

A high-speed centrifuge for the separation of gaseous isotopes is designed comprising a centrifugal pump mounted on the outlet of a centrifuge bowl and arranged to pump the heavy and light fractions out of the centrifuge bowl in two separate streams.

25608

CENTRIFUGES. J. W. Beams and L. B. Snoddy (to U. S. Atomic Energy Commission). U. S. Patent 2,948,572. Aug. 9, 1960.

Damping bearings for use on the shafts of an ultra-centrifuge were designed which are capable of passing through critical angular speeds. The shaft extending from one end of the rotor is journaled in fixed-plain bearings mounted on annular resilient shock-absorbing elements to dampen small vibrations. The shaft at the other end of the rotor is journaled in two damper-bearing assemblies which are so spaced on the shaft that a vibration node can at no time exist at both bearing assemblies. These bearings are similar to the other bearings except that the bearing housings are slidably mounted on the supporting structure for movement transverse to the rotational axis of the rotor.

25609

HOUSINGS AND MOUNTINGS FOR CENTRIFUGES. F. C. Rushing (to U. S. Atomic Energy Commission). U. S. Patent 2,949,045. Aug. 16, 1960.

A protective housing for a gas centrifuge comprises a slidable connection between flanges and framework portions for absorbing rotational energy in case of bursting of the rotor and a sealing means for sealing the rotor chamber.

Heat Transfer and Fluid Flow

25610 ANL-6213

Argonne National Lab., Ill.

AN EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER TO SUPERHEATED STEAM IN ROUND AND RECTANGULAR CHANNELS. J. B. Heineman. Sept. 1960. 100p. Contract W-31-109-eng-38. OTS.

Forced-convection heat transfer to superheated steam in turbulent flow was experimentally investigated, utilizing two-channel geometries: a round tube, 0.333-in. ID by 12.00 in., and a thin rectangular channel, 0.047-in. wide, aspect ratio, 26.6:1, and 12.00 in. in length. The experiments encompassed a Reynolds number range from 20,000 to 370,000, pressure range from 300 to 1500 psia, inlet superheat from 5 to 160°F, and film temperature differences from 30 to 550°F. (W.L.H.)

25611 CF-60-9-69

Oak Ridge National Lab., Tenn.

MOMENTUM AND HEAT TRANSFER TO A FLUID FLOWING TURBULENTLY IN A PIPE. R. J. Hefner. Sept. 15, 1960. 79p. OTS.

A mathematical model is presented for the prediction of heat-transfer coefficients for fully developed turbulent flow of fluids in circular pipes by analogy to the transfer of momentum. An empirical velocity-distribution equation derived from experimental data is presented for use in the analogy model. Heat-transfer coefficients for fluids with Prandtl numbers ranging from 0.01 to 100 and Reynolds

numbers ranging from 5×10^3 to 10^7 are presented in tabular and graphical forms for both the case of constant heat flux at the pipe wall and the case of constant temperature at the pipe wall. The calculated heat-transfer coefficients are compared with existing experimental data, and a discussion of the parameters affecting the heat-transfer characteristics of fluids in turbulent motion in circular pipes is presented. (auth)

25612 GEAP-3228(Rev.1)

General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.

PERFORMANCE—TWO-PHASE PRESSURE DROP, BURNOUT, AND HYDRAULIC OSCILLATION OF AN INCLINED TEST SECTION WITH NET STEAM GENERATION AT 1000 PSIA. S. Levy and C. L. Swan. Aug. 15, 1959. 26p. Contract AT(04-3)-189. OTS.

Burn-out, pressure-drop, and hydraulic-oscillation tests were performed in an annular geometry inclined 45° from the vertical. Data are presented for a uniformly heated rod, 0.540 in. in diameter and 9 ft 2 in. long, located within a circular pipe of 0.875-in. ID. All measurements were made with net steam generation at 1000 psia, and the test variables covered ranges previously studied in the vertical direction. The test results reveal that the performance of the inclined section can be readily determined from that of a vertical channel. (auth)

25613 LAMS-2436

Los Alamos Scientific Lab., N. Mex.

APPROXIMATE CALCULATION OF THE TEMPERATURE DISTRIBUTION SURROUNDING COOLANT HOLES IN A HEAT GENERATING SOLID WITH FINITE VALUE OF FLUID HEAT TRANSFER COEFFICIENT. T. R. Regenie and J. C. Rowley. June 20, 1960. 23p. Contract W-7405-eng-36. OTS.

Results are given of a study of the temperature distribution within a heat-generating solid cooled by the passage of a fluid through a net of small cylindrical holes spaced at the vertices of equilateral triangles. The effect of a finite value of the heat-transfer coefficient of the fluid and the resulting temperature differences on the surface of the cooling holes are determined. An approximate solution is obtained by use of a series of circular harmonics. This series is truncated to a finite number of terms and the integration constants are evaluated by boundary collocation. The results indicate that only for very close spacing of the coolant holes (very "lacy" structures) does the prediction of temperature differences in the generating solid vary significantly from the result for the infinite heat-transfer coefficient solution. (auth)

25614 MIT-NSL-TR-403

Massachusetts Inst. of Tech., Cambridge. Naval Supersonic Lab.

ON AN APPROXIMATE SOLUTION OF THE ENERGY EQUATION AND ITS APPLICATION TO THE McCLIMANS' DATA. Eugene E. Covert. Nov. 1959. 33p.

The energy equation for low-speed pipe flow is transformed by means of the Kirchhoff transformation. An approximate solution is found in terms of this variable which indicates that the usual parameters in forced convection can be generalized to allow for high rates of heat transfer and variable fluid properties. (auth)

25615 TID-6338

Ramo-Wooldridge. Div. of Thompson Ramo Wooldridge Inc., Canoga Park, Calif.

HYDRODYNAMIC ASPECTS OF NUCLEATE POOL BOILING. PART I. THE REGION OF ISOLATED BUB-

BLES. Novak Zuber. Jan. 27, 1960. 60p. (RW-RL-164). OTS.

The theory of Bošnjakovic and Jakob (bubble growth is limited by the rate of heat transfer) is extended to predict the rate of vapor formation, in steady or transient boiling, with the assumption that the evaporation takes place at the base of the bubble. The predicted values are in satisfactory agreement with experimental results. An analytical expression, in terms of the bubble population, is derived for the velocity of the liquid adjacent to the heating surface. This velocity is used to estimate the heat transfer in nucleate boiling. Experimental data indicate that when bubbles can be considered as isolated, the heat transfer in nucleate boiling is intermittent and bears a similarity to the transfer of heat from a flat plate with boundary-layer formation. Experimental data indicate also that as the vapor void fraction (vapor hold-up) on the heating surface increases, a change occurs in the hydrodynamic conditions of the two-phase system. This change occurs at a heat-flux density well below the critical heat flux. The vapor removal is altered from an intermittent to a continuous process. The mechanism of heat transfer is affected but not the process. An equation is derived for analyzing the relation which exists between the heat-flux density, the liquid-superheat temperature, and the bubble population in nucleate pool boiling. The predicted values are in qualitative and quantitative agreement with available experimental results. (auth)

25616 Y-1309

Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn. EVALUATION OF DISCONTINUITIES IN A STAINLESS STEEL WELDMENT WITH RADIOGRAPHIC AND ULTRASONIC TECHNIQUES. F. J. Lambert and P. J. Long. Apr. 15, 1959. 23p. Contract W-7405-eng-26. OTS.

An investigation was conducted to compare the radiographic and pulse-echo, shear-wave ultrasonic inspection data from a weldment in a Type 304L stainless-steel plate $\frac{1}{4}$ in. thick. Metallographic specimens were obtained at points of agreement and disagreement between the two inspection methods in order to evaluate the test results. (auth)

25617 AEC-tr-3875

PRESSURE LOSS AND HEAT TRANSFER FOR TURBULENT FLOW. (Druckverlust und Wärmeübergang bei Verwirbelter Strömung). Rudolph Koch. Translated from *VDI-Forschung*, sh. No. 469, p.1-44. Suppl. to *Forschung. Geb. Ingenieurw.* 24B (1958). 139p. OTS.

Pressure loss and heat transfer were determined in a smooth tube both with and without different passive turbulence-producing arrangements (disks, rings, baffle plates, propellers, helically twisted metal strips, and packing materials at Reynolds numbers of ~ 500 to 80,000. Measurements of the velocity, temperature distributions, and wall-shear stress were made for all cases. The economy of each arrangement is discussed. (C.T.G.)

25618 AEC-tr-4218

HEAT TRANSFER TO LIQUID METALS IN TURBULENT FLOW WHEN THE THERMAL LOAD IS DISTRIBUTED SINUSOIDALLY ALONG THE LENGTH OF THE PIPE. (Teplootdacha k Turbulentnomu Potoku Metalla pri Sinusoidal'nom Raspredelenii Teplovoi Nagruzki po Dline Truby). V. I. Petrovichev and L. S. Kokorev. Translated from *Inzhener.-Fiz. Zhur.*, Akad. Nauk Belorus. S.S.R. 2, No. 12, 20-5(1959). 11p. JCL or LC.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 14, as abstract No. 6417.

25619

DETERMINATION OF HEAT TRANSFER FROM SPHERI-

CAL PACKINGS TO GAS FLOWING THROUGH THEM USING THE MASS TRANSFER ANALOGY. C. B. von der Decken, H. J. Hantke, J. Binckebanck, and K. P. Bachus (BBC-Krupp, Düsseldorf, Ger.). Chem.-Ingr.-Tech. **32**, 591-4(1960) Sept. (In German)

With the aid of the mass transfer-heat transfer analogy the heat transfer from spherical packings to gas flowing through them was determined. For this purpose naphthalene spheres were arranged in a heap and the weight loss after passage of air through them was measured. From this the heat transfer was calculated and its variation as a result of the statistically different position of the individual spheres was determined. The results are in good agreement with other methods that did not make it possible to predict the variation in heat transfer from sphere to sphere. (auth)

25620

HEAT TRANSFER TO A GAS IN PACKED AND CONTACT TUBES. R. Schumacher (Rütgers-Werke A. G., Frankfurt am Main). Chem.-Ingr.-Tech. **32**, 594-7(1960) Sept. (In German)

The factors influencing heat transfer in packed and contact tubes were classified so that a correlation of previously known experimental results became possible. Reynolds numbers referred to the tube diameter $Re < 1600$, $Re = 1600$ to $10,000$, and $Re > 10,000$ characterize three flow ranges in which the influence of tube length on heat transfer is of a different magnitude. Optimum heat transfer for all flow ranges was obtained if the diameter of the packing material was one-eighth the tube diameter. (auth)

25621

GROWTH OF VAPOR BUBBLES IN A RAPIDLY HEATED LIQUID. S. A. Zwick (California Inst. of Tech., Pasadena). Phys. Fluids **3**, 685-92(1960) Sept.-Oct.

The earlier theory of the growth of vapor bubbles in superheated liquids is extended to the situation in which the rate of temperature rise of the liquid is large. Numerical solutions are presented for the early stages of bubble growth for various rates of liquid temperature rise. The asymptotic behavior of a bubble is found explicitly for a temperature rise of the liquid which is linear in time. In this case the bubble radius grows initially as $t^{1/2}$, as in asymptotic solutions found previously for small rates of temperature rise, but then deviates toward a late $t^{2/3}$ variation. (auth)

25622

HEATING AND COOLING SYSTEM FOR CALUTRON. A. M. Starr (to U. S. Atomic Energy Commission). U. S. Patent 2,943,195. June 28, 1960.

An apparatus is invented for heating or cooling the electrostatic liner conventionally disposed in a calutron tank. The apparatus is additionally arranged to mount the liner in its intended position in a readily detachable manner so as to facilitate disassembly of the calutron.

25623

HEAT TRANSFER METHOD. W. R. Gambill and N. D. Greene (to U. S. Atomic Energy Commission). U. S. Patent 2,950,604. Aug. 30, 1960.

A method is given for increasing burn-out heat fluxes under nucleate boiling conditions in heat exchanger tubes without incurring an increase in pumping power requirements. This increase is achieved by utilizing a spinning flow having a rotational velocity sufficient to produce a centrifugal acceleration of at least $10,000 g$ at the tube wall. At this acceleration the heat-transfer rate at burn-out is nearly twice the rate which can be achieved in a

similar tube utilizing axial flow at the same pumping power. At higher accelerations the improvement over axial flow is greater, and heat fluxes in excess of 50×10^6 Btu/hr/sq ft can be achieved.

Instrumentation

25624 A/AC.82/G/L.397

Rikkyo Univ., Tokyo.

MEASUREMENTS OF RADIATION DOSES DUE TO BACKGROUND GAMMA RAYS BY PLASTIC SCINTILLATORS. Tadayoshi Doke, Yasukiyo Takami, Atsushi Nakamoto, and Akira Sasaki. May 1960. 13p.

Relative responses of the two cylindrical plastic scintillators (1 in. in diameter \times 1 in. and 2 in. \times 2 in.) to air doses were calculated for γ rays of energy ranging from 0.1 to 2.0 Mev, with variation of the incident directions. The results of the calculations showed that the relative responses did not practically depend upon the energies and incident directions of γ rays. On the bases of these results, the dose rates were measured from background γ rays both outdoors and indoors. The dose rates obtained by the measurements inside buildings were 48 to 68 mr/year. On the other hand, the dose rate from the terrestrial γ rays was 27.5 mr/year, which was only one-third of the world average. Such low value was ascribed to the low activity of the soil (composed of volcanic ash) in Kanto district. Also, the accumulated dose was estimated from fission products deposited on the ground (in Chiba City) to be about 30 mr during the period from November 1958 to December 1959. (auth)

25625 AERE-R-2942

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

LIQUID SCINTILLATION COUNTING OF AQUEOUS SAMPLES. B. A. Loveridge and A. M. Thomas. June 1960. 29p. BIS.

The application of liquid scintillation coincidence counters for monitoring beta activity in plant effluent or drinking water was evaluated and found to be practical. (C.J.G.)

25626 AERE-R-3424

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE USE OF HELICAL SPRING BALANCES IN PHYSICO-CHEMICAL RESEARCH. R. M. Dell and V. J. Wheeler. July 1960. 16p. BIS.

The precautions are discussed which must be observed in the use of sensitive helical springs as gravimetric balances in studying chemical reactions involving solids. Thermostating of such springs is shown to be important because of significant changes in their length with changing temperature. Measurements are made of the contraction of silica springs and the expansion of copper-beryllium springs with rise of temperature. These effects are related to the temperature coefficient of the modulus of rigidity of the material. A discussion of buoyancy effects in a static gas atmosphere shows that these are small for all springs, regardless of their sensitivity. However in a flowing gas atmosphere, as required in a study of solid-gas reactions, there is a viscous drag on the sample holder and the spring which results in a marked, but steady, deflection. The magnitude of this effect is investigated for various gas flows and experimental arrangements. (auth)

25627 AERE-R-3437

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE SOLID-STATE SURFACE BARRIER CHARGED PARTICLE DETECTOR. G. Dearnaley and A. B. Whitehead. Aug. 1960. 35p. BIS.

The present state of development of solid-state surface-barrier charged-particle detectors is summarized in terms of surface-state formation, construction techniques, circuit and amplifiers, characteristics of gold-silicon and gold-germanium detectors, nuclear-physics applications, and special configurations. (W.D.M.)

25628 AFCRC-TR-60-112

Nuclear Science and Engineering Corp., Pittsburgh. OPERATION AND MAINTENANCE MANUAL—8-COUNTER LOW BACKGROUND NUCLEAR RADIATION MEASUREMENT SYSTEM. Jan. 18, 1960. 47p. Contract AF19(604)-3874. (AD-233727).

A manual of operation and maintenance for an 8-counter low-background nuclear-radiation measurement system is presented. Each counter is independent of the others so that individual sample changes may be made in any counter without disturbing operation of the remainder. Eight samples can be counted at once for the relatively long periods required to obtain a statistically sufficient number of counts. (J.R.D.)

25629 CEA-1429

France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay.

SPECTROGRAPHIE γ [A SCINTILLATIONS]. PRINCIPES [PHYSIQUES. APPAREILLAGE]. UTILISATION. (Scintillation γ Spectrography. Physical Principles. Apparatus. Operation). C. Julliot. 1960. 58p.

The scintillation detector forms the main part of the instrument used, the electronic unit presenting the results produced. After a brief description of the process of γ -photon absorption in the material, the particular case of NaI(Tl), the scintillator used, is examined. The intensity of the scintillation caused by γ -ray absorption and the characteristics of the photomultiplier play a determining part in the energy resolution of the instrument. For the γ -recording spectrograph, we show to what extent the technique for using the electronic unit can modify the results. A detailed description is given of the activity measurement of a γ -emitting radioelement by the spectrographic method. (auth)

25630 CERN-60-28

European Organization for Nuclear Research, Geneva. THE LINAC RF POWER SYSTEM BELOW 400 kW. U. Kracht. [1960]. 22p.

The operation of an r-f pulsed power system at 300 to 400 kw to drive the 2.5-Mw amplifiers of the 50-Mev proton linear accelerator is described. Pulse duration is $\sim 200 \mu s$, and the repetition rate is one pulse per second. A description of the quartz-crystal-controlled transmitter and the two power amplifiers, which are all connected in cascade, is included. (C.J.G.)

25631 CF-59-8-101

Oak Ridge National Lab., Tenn. IN-LINE GAMMA MONITORING. T. S. Mackey. Aug. 26, 1959. 16p. OTS.

Two cell designs (a fluorothene-tube cell and a falling-stream monitoring cell) were tested for in-line gamma monitoring. A successful performance of the fluorothene-tube cell is reported. The designs, operation, and performance of each cell are discussed. (C.J.G.)

25632 CRDLR-3020

Army Chemical Research and Development Labs., Army Chemical Center, Md.

A SURVEY OF SOLID-STATE GAMMA/NEUTRON DETECTION SYSTEMS. Russell Gminder, John W. Kinch, Arthur L. Knipp, Jr., and John H. McNeilly. July 1960. 64p.

A bibliography is presented on the major advantages and limitations of many solid-state detection systems. Some recently proposed and partially studied systems are also discussed. The systems were classified according to the radiation-induced effect utilized for measurement. The bibliography consists of 197 references. (W.L.H.)

25633 LAMS-2445(p.136-40)

Los Alamos Scientific Lab., N. Mex. CALIBRATION OF LARGE VOLUME DETECTORS FOR ABSOLUTE MEASUREMENT OF Cs^{137} . E. C. Anderson and M. A. Van Dilla.

The problem of absolute calibration of large volume detectors for Cs^{137} measurement is discussed. Data are tabulated from calibrations of the first model Los Alamos large volume liquid scintillation detector (Humco-I) made with new sets of independent Cs^{137} standards. (C.H.)

25634 LAMS-2445(p.163-9)

Los Alamos Scientific Lab., N. Mex. STUDIES OF THE FEASIBILITY OF DESIGNING A LUNAR GAMMA RAY SPECTROMETER. M. A. Van Dilla and E. C. Anderson.

Studies are described which are preliminary to the design of a gamma-ray spectrometer for use in a close lunar satellite for measuring gamma-ray emission from the lunar surface. The proposed experiment will provide information relevant to the composition and geologic history of the moon and the radiation intensity at its surface. Results are reported from preliminary measurements of gamma activities of certain meteoritic types and terrestrial minerals which may possibly be found on the surface of the moon. Theoretical predictions of concentrations of both natural and cosmic ray induced radioactivity are presented. (C.H.)

25635 LAMS-2445(p.170-8)

Los Alamos Scientific Lab., N. Mex. DEVELOPMENT OF LARGE VOLUME LIQUID SCINTILLATION DETECTORS. R. L. Schuch, J. D. Perrings, and E. C. Anderson.

The development of large-volume liquid scintillation detectors for use in whole-body counting is reviewed. Design features of a 4π counter, the Humco I; a 2π walk-in counter, the Genco; and an improved 4π counter, the Humco II, are described. Operation of the Humco II is discussed. Transistorized electronic circuits allow direct transfer of output data to IBM punched cards. (C.H.)

25636 LAMS-2445(p.179-83)

Los Alamos Scientific Lab., N. Mex. DEVELOPMENT OF A LIQUID SCINTILLATION COUNTER FOR SMALL ANIMAL STUDIES. R. L. Schuch.

Design improvements are reported for a liquid scintillation counter for use in whole-body counting of small animals. (C.H.)

25637 LAMS-2445(p.184-95)

Los Alamos Scientific Lab., N. Mex. FEASIBILITY STUDIES OF AN ADJUSTABLE PLASTIC SCINTILLATOR COUNTING SYSTEM. M. A. Van Dilla and R. L. Schuch.

A scintillation counter consisting of a flexible system of individual cylinders of plastic scintillator was constructed,

and certain performance characteristics were studied. The primary purpose of this work was to develop a sensitive gamma-ray detector with an adjustable arrangement and sample size capable of obtaining maximum energy sensitivity and resolution from a plastic scintillator system. Some potential applications of such a unit may be metabolic studies of gamma-emitting isotopes in animals, measurement of rate of build-up of very low levels of activity on adsorption and purification columns, measurement of rate of flow of very low specific activity solutions through piping systems, and studies of uniformity of radioactively impregnated films. Results are reported from preliminary measurements. (auth)

25638 LAMS-2445(p.211-12)

Los Alamos Scientific Lab., N. Mex.

NEW LIQUID SCINTILLATORS FOR LARGE VOLUME APPLICATIONS. V. N. Kerr, F. N. Hayes, et al.

Solvent transmissibility and relative pulse heights (RPH) of several solvent, solute, scintillator combinations were measured using 12-liter volumes of scintillator solution. Data are tabulated. Additional information is included concerning a few new solvents which indicate their possible usefulness as large-volume scintillator fillings. (auth)

25639 LAMS-2445(p.219-23)

Los Alamos Scientific Lab., N. Mex.

PHOTODETECTORS FOR LIQUID SCINTILLATION DOSIMETRY IN THE FIELD. D. L. Williams, F. N. Hayes, and R. L. Schuch.

A study was made of photodetectors for use with paired liquid scintillation detectors for measuring the dose rate of each component of a mixed radiation field. A detector for high dose rates was constructed and tested. Data are presented graphically. (C.H.)

25640 NP-9167(p.157-62)

Tata Inst. of Fundamental Research, Bombay.

LARGE AREA TRIGGERED SPARK COUNTERS FOR COSMIC RAY EXPERIMENTS. N. B. Mistry, G. T. Murthy, P. V. Ramanamurthy, and B. V. Sreekantan.

Large-area spark counters were developed to locate the position of jets produced by high-energy cosmic-ray particles. Brass welding rods were placed parallel to each other on a plastic frame. Aluminum angles were fixed to the frame to keep it straight. A stainless-steel plate was fixed to the frame with screws. The voltage on the spark counter was pulsed by a thyratron circuit. The efficiency for minimum-ionizing particles could be varied from 0.1 to 70%. With the counter adjusted for an efficiency of 5% for minimum-ionizing particles, the efficiency of response to α particles was almost 100%. To make the spark counter system respond only to high-energy jets, a double spark counter was used. This system also gave the direction of the jet and helped in defining the co-ordinates more accurately when operated with nuclear emulsions. (M.C.G.)

25641 NP-9167(p.264-5)

Aligarh Muslim Univ., Aligarh, India.

THE TRACK FORMATION IN NUCLEAR EMULSIONS. Y. Prakash and A. P. Sharma.

It is assumed that the grain in a nuclear emulsion will be rendered developable if one or more silver atoms move into one or more sensitivity centers in the grain. The average number of these sensitivity centers containing at least one silver atom may be calculated provided that the number of electrons effective for the latent image formation and the number of sensitivity centers are known. (M.C.G.)

25642 NP-9167(p.266-73)

Tata Inst. of Fundamental Research, Bombay.

GAS Cerenkov COUNTERS FOR COSMIC RAY RESEARCH. V. K. Balasubramanian, S. K. Roy, A. Subramanian, and S. D. Verma.

Gas Cherenkov counters have an energy response suitable for work at higher energies since gases at NTP have refractive indices close to unity. Several applications of the gas Cherenkov counter are given. Some of the experiments on cosmic radiation for which these counters are being fabricated and tested include verification of the geomagnetic theory, estimation of re-entrant albedo proton flux, and the relative abundance of He^3 and He^4 in primary cosmic radiation. (M.C.G.)

25643 NP-9167(p.274-9)

Tata Inst. of Fundamental Research, Bombay.

A NEW TECHNIQUE OF COUNTING LOW LEVEL β -ACTIVITY. P. K. Zutshi.

A new scintillation technique was developed for measuring low-level β activity. The source was deposited on a circular filter paper which was soaked with a few drops of p-terphenyl in toluene; the filter paper was then sealed in a mylar bag to prevent evaporation of the toluene; and the mylar bag was then placed between two photomultipliers and the coincidence recorded. The activity of composite sources may also be measured. (M.C.G.)

25644 ORNL-2978

Oak Ridge National Lab., Tenn.

INLINE INSTRUMENTATION: GAMMA MONITOR, URANIUM COLORIMETER. J. W. Landry. Sept. 19, 1960. 25p. Contract W-7405-eng-26. OTS.

Methods of applying gamma scintillation spectrometry and uranium colorimetry based on differential absorption of two light wavelengths are described. These methods are under development at ORNL for continuous analysis of radiochemical process plant streams. The instruments are capable of automatic standardization and background subtraction. (auth)

25645 PIBMRI-840-60

Brooklyn. Polytechnic Inst. Microwave Research Inst.

MILLIMETER WAVES. Bernard Epsztajn. July 25, 1960. 47p. Contract AF18(600)-1505. (AFOSR-TN-60-850).

A method of millimeter wave generation which combines some features of the traveling wave parametric amplifier and the Doppler effect is presented. More conventional methods are reviewed along with some which are considered unorthodox. (J.R.D.)

25646 SCR-194

Sandia Corp., Albuquerque, N. Mex.

AN INVESTIGATION OF LONG-TERM STABILITY OF ZENER VOLTAGE REFERENCES. R. P. Baker and J. Nagy, Jr. June 1960. 21p. OTS.

Preprinted for 1960 Conference on Standards and Electronic Measurements, Boulder, Colorado, June 1960.

Silicon junction (zener) diodes were investigated for use as a voltage reference in a militarized test set capable of operating many months in adverse environments without restandardization. It was found that diodes can be selected with respect to temperature coefficient, noise, and long-term stability that have sufficient stability to replace unsaturated standard cells. The average standard deviation observed for 11 selected diodes tested for four months was 3.1 ppm. (auth)

25647 SCTM-73A-60(16)

Sandia Corp., Albuquerque, N. Mex.

CONTACT RESISTANCE AND THE EFFECTS OF MATERIALS AND PROCESS VARIABLES ON CONTACT RESIST-

ANCE AND CONTACT RELIABILITY IN SWITCHING DEVICES. L. M. Berry, L. K. Jones, and D. E. Fjelseth. Feb. 17, 1960. 48p. OTS.

The problems of manufacturing high-reliability switch devices are discussed. Materials and process variables which affect contact resistance are discussed. The properties of metals for use as contact surfaces are described. Procedures for processing and assembling metal surfaces are given. Methods for identification of surface contaminants are described. (C.J.G.)

25648 TID-6218

Chicago. Univ. Labs. for Applied Science.

THE CHanneled IMAGE INTENSIFIER. Quarterly Progress Report No. 8. May 31, 1960. 20p. Contract AT(11-1)-647. OTS.

Experiments were performed to determine the reasons for low gain in the channeled image intensifier. Low secondary-emission ratios appeared to be the major source of trouble with misalignment a close second source. The dynode design was found to be a contributing factor in that it produced an electron crossover too close to the plane of the dynode which led to electron trajectories that diverged too much. Attempts to improve gain by offsetting or staggering the dynodes were unsuccessful. (For preceding period see TID-5665.) (C.J.G.)

25649 TID-6296

Ramo-Wooldridge. Div. of Thompson Ramo Wooldridge Inc., Denver.

THERMAL NEUTRON DETECTION USING ELECTROMAGNETIC WAVEGUIDES. Final Report. L. T. Ostwald and P. D. Wickersham. May 31, 1960. 105p. Contract AT(04-3)-165, Project Agreement No. 2. OTS.

A study of the basic feasibility of a method of thermal-neutron detection employing a gas-filled electromagnetic waveguide is reported. The essential content of the theoretical study is presented; a description of the operating principle, a calculation of the expected performance of the detector, and a description of the experimental evaluation tests are given. The physical parameters upon which the performance of the detector depends are determined. The most important physical parameter governing the detector operation is determined to be the fill-gas purity. It is concluded that the application of microwaves to the detection of thermal neutrons would require careful microwave instrumentation design and the strictest attention to the preparation and encapsulation of a high-purity fill gas. For possible further studies, a method of evaluating gas-filled detector chambers prior to reactor testing is suggested. (auth)

25650 TID-6534

Sloan-Kettering Inst. for Cancer Research, New York.

THE DIRECT MEASUREMENT OF LOCAL ABSORBED DOSE BY CALORIMETRY. INVESTIGATION OF THE RELATION BETWEEN THE ENERGY ABSORBED IN A MEDIUM EXPOSED TO X-RAYS AND ELECTRONS, THE IONIZATION PRODUCED IN A GAS CAVITY CHAMBER IN THE SAME ABSORBING MEDIUM, AND THE OXIDATION OF FERROUS SULFATE IN THE FRICKE DOSIMETER. Annual Progress Report [for] July 1, 1959-June 30, 1960. John S. Laughlin. Aug. 3, 1960. 10p. Contract AT(30-1)-1451. OTS.

Design and construction of an absorbed-dose calorimeter fabricated of pure carbon were completed. Measurements of the absorbed dose in carbon from a Co^{60} gamma-ray beam and from 250 and 150 Kvp x rays were completed. Parallel chemical and ionization measurements were made for these radiations. The G value for oxidation of ferrous

sulfate in the Fricke dosimeter by Co^{60} gamma rays was determined on the basis of these measurements to be $15.24 \pm 1.2\%$ ferric ions per 100 ev. The existence of a chemical correction in irradiated polyethylene was confirmed by these measurements. With Co^{60} gamma rays, W for air was determined to be 34.9 ev per ion pair $\pm 0.9\%$. Data for the 250 and 150 Kvp x-ray irradiations are now being processed. (auth)

25651 UCRL-5665(p.154-61)

Los Alamos Scientific Lab., N. Mex.

INSTRUMENTATION FOR PULSED NEUTRON WORK AT LOS ALAMOS. PART I. G. R. Keepin.

For the broad range of pulsed experiments contemplated at Los Alamos, a Cockcroft-Walton positive ion accelerator was selected as the most versatile pulsed-neutron source obtainable. This selection is justified and block diagrams are shown of the beam-deflection and arc-pulsing systems. (W.D.M.)

25652 UCRL-5687

California. Univ., Livermore. Lawrence Radiation Lab.

IGNITRON DISCHARGE GROWTH DURING 10^8 -WATT PULSES. D. B. Cummings. June 3, 1960. 89p. Contract W-7405-eng-48. OTS.

Kerr-cell photographs were taken of glass ignitrons carrying up to 21,000 amp with rise times as short as $1.25 \mu\text{sec}$. These showed early, growing striations and occasional pinches. Later exposures showed cathode and anode vapor jets. A circle of light bounded by arc spots spread out from the ignitor with velocities up to 2×10^6 cm/sec. The peak velocity was proportional to the 0.7 power of capacitor voltage and directly proportional to the noninductive component of tube voltage drop. The effects of ringing frequency and temperature were determined. Plasma floating potential was measured with an auxiliary anode. The behavior and theory of mercury arcs were reviewed. Possible arc front propagation mechanisms were considered. Malter-effect field emission appeared most probable and a model was developed. Calculations of this model were consistent with the measured velocities. (auth)

25653 UCRL-6005

California. Univ., Livermore. Lawrence Radiation Lab.

A SPECTROMETER FOR STUDY OF NEUTRON ACTIVATION OF BERYLLIUM-7 AS A FUNCTION OF ENERGY. Walton T. Boyer, Jr. May 18, 1960. 38p. Contract W-7405-eng-48. OTS.

A neutron diffraction crystal spectrometer with a resolution of $13 \mu\text{sec/m}$ and monochromatic beam intensity up to 10^4 neutrons/cm²/sec in the range 0.012 to 0.400 ev was constructed for study of the activation cross section of Be^7 as a function of energy in the thermal region. First preliminary results using ZnS(Ag) as a detector suggest the possibility of a resonance for the $\text{Be}^7(n,p)\text{Li}^7$ reaction in the region of 0.025 to 0.050 ev. (auth)

25654 UCRL-9235(p.29-55)

California. Univ., Berkeley. Lawrence Radiation Lab.

SCINTILLATION AND POSITRON CAMERAS. Hal O. Anger. (UCRL-8640).

The design features are described of a scintillation camera in which a pinhole aperture is situated in a lead camera body so that it projects a gamma-ray image of the subject on a large, flat sodium iodide crystal. Remote viewing and recording are feasible. A sectional view of the camera is shown, and the sensitivity and resolution are discussed. Uses of the scintillation camera with positron-emitting radioisotopes are described. The performance of both single-crystal and double-crystal positron cameras

is described. A list of positron-emitting isotopes is included. (C.H.)

25655 UCRL-9291

California. Univ., Berkeley. Lawrence Radiation Lab. INSPECTION OF A FIRE-DAMAGED RADIATION SOURCE. Patrick W. Howe, Joseph E. Rainey, and Harvey F. Soule. June 29, 1960. 11p. Contract W-7405-eng-48. OTS.

A commercially manufactured Cs¹³⁷ radiation density gage was inspected after a severe fire. The primary container came through the fire without any spread of radioactivity. (auth)

25656 WADD-TR-60-246

Martin Co., Baltimore. RADIOISOTOPE TUBE HEATER. Mar. 1960. 72p. Project No. 4156. Contract AF33(616)-6325. OTS.

An attempt was made to demonstrate the feasibility of heating a vacuum tube cathode using a radioisotope-fueled heat source. The objective was achieved when emission and amplification were obtained using a 300-c Po²¹⁰ heat source, encapsulated in a double stainless-steel container, to heat the cathode of a Type X-766 vacuum tube. The tube and heat source were assembled together and provided with a manual temperature-control system. Operation of the temperature-control system proved that the decreasing heat output of a decaying radioisotope can be controlled to obtain constant cathode temperature. Tube characteristics were obtained using an electrical simulated heater prior to final tests with the radioisotope fuel source installed. No correlation was obtained between the characteristics obtained with the two heating systems because the maximum cathode temperature achieved using the radioisotope was 640°C, while the cathode temperature for the electrically heated tests was 700°C. Various tube configurations were tested prior to final tests, and the conceptual design of an operational tube is presented. Further development is recommended, particularly with regard to cylindrical tube element designs for high-power radio-frequency amplification. (auth)

25657 WAPD-T-1176

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

REMOTE SURFACE INSPECTION TECHNIQUES. R. A. Betz. 1960. 9p. Contract AT-11-1-GEN-14. OTS.

Several types of remote-inspection apparatus are discussed relative to application, operation, and limitations. (C.J.G.)

25658 Y-1313

Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn. TRANSISTORIZED PULSE COUNTING EQUIPMENT. John J. Henry. July 26, 1960. 25p. Contract W-7405-eng-26. OTS.

A hermetically sealed completely transistorized pulse-counting system, designed to operate in corrosive environmental conditions in chemical process areas, is described. The equipment performance compares favorably with that of the high-quality vacuum tube equipment it was designed to replace. It is designed to indicate the amount of radiation present greater than a certain energy level. Although specifically applicable to nuclear radiation measurement, other possible uses include tachometers, flowmeters, and many types of frequency-measuring devices. (auth)

25659 CEA-tr-R-824

CHAMBRE D'IONISATION POUR LE COMPTAGE DE PARTICULES ALPHA. (Ionization Chambers for Counting Alpha Particles). S. S. Bugorkov (Bougorkov), L. Z. Maklin (Makline), K. A. Petrazhak (C. A. Peterjack), V. A.

Yakovlev, and M. I. Yakunin (Yakounine). Translated into French from *Pribory i Tekh. Ekspt.* No. 4, 16-19(1957). 13p.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 12, as abstract No. 10836.

25660 CEA-tr-R-877

GÉNÉRATEUR D'IMPULSIONS DE L'ORDRE DE LA MICROSECONDE AVEC UNE FRÉQUENCE DE RÉPÉTITION ÉLEVÉE. (Microsecond Pulse Generator with High Repetition Frequency). B. A. Mamyrin (Mamyryne). Translated into French from *Radiotekhnika* 13, No. 11, 27-38(1958). 23p.

A study is reported on a method of generation of pulses of the order of millimicroseconds with a frequency of repetition of the order of kilocycles for an output potential of several hundred volts. A method was developed for calculating such a pulse generator, and the operating conditions for an output tube are given. (tr-auth)

25661 CEA-tr-R-923

DETECTEUR À IONISATION, AU PROMÉTHÉUM-147, POUR LA CHROMATOGRAPHIE GAZEUSE. (Ionization Detector with Promethium-147 for Gas Chromatography). S. N. Oziraner, G. A. Gaziev, M. I. Yanovskii (Yanovski), and V. S. Korniaikov. Translated into French by B. Vlnogradoff from *Zavodskaya Lab.* 25, 760-1(1959). 8p.

The use of α sources in gas chromatography is not feasible because of cost and safety hazards. The use of a Pm¹⁴⁷ β source electrolytically deposited on 2 cm² of oxide surface is described. The source has an activity of 2.5 mc/cm², a period of 2.7 years, and a maximum β energy of 0.22 Mev. The detector consists of two cylinders separated by teflon. One is swept out by pure H₂, He, or air, and the other is connected to the chromatography column and receives the gas mixture to be analyzed. The difference in potential across the two chambers is measured and is a function of the composition of the gas mixture. (T.R.H.)

25662 JPRS-5016(p.136-58)

SCINTILLATION GAMMA-ENCEPHALOMETER FOR THE DIAGNOSIS OF BRAIN TUMORS. K. N. Badmaev (Badmayev), S. G. Zen'kovich, and I. A. Sokolov. Translated from *Med. Radiol.* 5, No. 4, 57-64(1960).

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 14, as abstract No. 15790.

25663 JPRS-5016(p.159-65)

ROENTGENOMETER FOR MEASURING THERAPEUTIC DOSES. R. V. Stavitskiĭ (Stavitskiy). Translated from *Med. Radiol.* 5, No. 4, 65-7(1960).

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 14, as abstract No. 15791.

25664 JPRS-5016(p.166-75)

INVESTIGATION OF AN AQUEOUS CHLOROFORM SOLUTION AS A DOSIMETER OF X- AND γ -RADIATION. I. K. Sokolova. Translated from *Med. Radiol.* 5, No. 4, 68-71(1960).

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 14, as abstract No. 15508.

25665 JPRS-5016(p.176-85)

RADIOMETRIC MEASUREMENTS UNDER CONDITIONS OF A VERY VARIABLE BACKGROUND. B. A. Glazun. Translated from *Med. Radiol.* 5, No. 4, 72-5(1960).

This paper was previously abstracted from the original

language and appears in NSA, Vol. 14, as abstract No. 15792.

25666 JPRS-5016(p.186-8)
INTRACAVITARY SCINTILLATION BETA-RAY SOUND. I. K. Tabarovskii (Tabarovskiy). Translated from Med. Radiol. 5, No. 4, 76(1960).

An intracavitary scintillation β -ray sound was designed for early local diagnosis of malignant tumors of the cervix of the uterus and vaginal cavity by means of contact recording of the β radiation from P^{32} accumulating in the tumors. This instrument consists of a plastic scintillator, plexiglass light conductor, photomultiplier, and preamplifier with a matching cascade. (M.C.G.)

25667 JPRS-5016(p.189-91)
DIAGNOSTIC SCINTILLATION DSU-60 APPARATUS. I. K. Tabarovskii (Tabarovskiy). Translated from Med. Radiol. 5, No. 4, 77(1960).

A diagnostic scintillation apparatus was designed for determining the dynamics of I^{131} accumulation by the thyroid gland. The apparatus is made up of the following sections: a scintillation feeler, consisting of protective casing, collimators, a γ scintillation detector, a photomultiplier, and a matching cascade; a single-channel, amplitude differential pulse discriminator; a measuring device and recorder; a time relay and indicator showing the accumulation of I^{131} in percentages; a rectifier with voltage stabilizer; and a stand with a mechanism for setting up and fixing the position of the feeler. (M.C.G.)

25668 JPRS-5403(p.46-56)
THE STATUS AND PROSPECTS OF DEVELOPMENT OF RADIOLOGICAL PROTECTIVE EQUIPMENT FOR MEDICAL INSTITUTIONS. V. I. Gordon, V. V. Dmukhovskii (Dmukhovskiy), and A. F. Rimman. Translated from Med. Radiol. 5, No. 5, 22-6(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 20366.

25669 NP-tr-484
LEAK TESTING BY MEANS OF HELIUM. C. Level de Curnieu. Translated by S. Pease (U.K.A.E.A. Atomic Energy Research Establishment) from p.197-211 of "VI Rassegna Internazionale Elettronica e Nucleare. Atti Del Congresso Scientifico, Giugno 1959. Sezione Nucleare. Volume I." A publication of Comitato Nazionale Ricerche Nucleari, Rome. 20p. (Handwritten MS. Copy). JCL.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 9628.

25670 UCRL-Trans-598(L)
INVESTIGATIONS AND EXPERIMENT ON A DYNAMIC SECONDARY ELECTRON MULTIPLIER. Heinz Beneking. Translated by W. D. Kilpatrick from Z. angew. Phys. 4, 258-67(1952). 29p. JCL.

The case was investigated in which primary electrons pass through an alternating electric field and produce secondary electrons by dynamic multiplication. These electrons are then removed in the opposite direction of the secondary-emission surface as incident primary electrons. Various aspects of this arrangement are discussed along with experimental results. Data for tube design and other practical applications are included. (J.R.D.)

25671
DIFFUSION-CONDENSATION CHAMBER. Gheorghe Văsar. Acad. rep. populare Romîne, Inst. fiz., atomică și Inst. fiz. Studii cercetări fiz. 11, No. 1, 175-97(1960). (In Rumanian)

In spite of the great success of the Wilson cloud chamber, the need arose in high-energy physics research for a con-

tinuous recording of the track of ionizing particles. This was achieved by the diffusion-condensation chamber, used already for the determination of the cross section of nuclear reactions, for the measurement of extremely low activities, and for the behavior of particles in electric and magnetic fields. However, at high pressures constructional difficulties are observed, and accordingly at very high energy levels the bubble chambers are considered more satisfactory. Constructional details and theoretical basis of the operation are presented. 79 references. (TTT)

25672

A SIMPLE APPARATUS FOR THE EXACT DETERMINATION OF THE THERMAL CONDUCTIVITY OF GASES. R. Bucur, T. Fodor, and I. Mercea. Acad. rep. populare Romîne, Inst. fiz., atomică și Inst. fiz. Studii cercetări fiz. 11, No. 1, 211-15(1960). (In Rumanian)

A novel apparatus, based on previously described principles, was constructed for the analysis of binary gas mixtures, the approximate determination of the isotopic composition of gases, and for use in gas chromatography. The apparatus presents a low inertia when exposed to composition changes and has the ability of indicating variations in the thermal conductivity of the order of 10^{-8} to 10^{-9} cal/sec/cm²/°C. The sensing element consists of 0.05-mm diameter platinum wire in a 2-mm diameter coil connected to a bridge. Measurements were made with mixtures of CH₄-CO₂ and CH₄-N₂, using CH₄ for calibration and with H₂-CH₄, H₂-N₂, and H₂-He, using H₂ as the reference gas. The temperature of the platinum resistance units varied from 63°C (for CO₂) to 23°C (for H₂); whereas the wall temperature was maintained at 20.5°C. The apparatus was used successfully for the chromatographic study of deuterium. (TTT)

25673

TWO APPARATUSES USED FOR THE STUDY OF ISOTOPIC EFFECTS IN THE GAS PHASE. I. Ursu and T. Fodor. Acad. rep. populare Romîne, Inst. fiz., atomică și Inst. fiz. Studii cercetări fiz. 11, No. 1, 215-20(1960). (In Rumanian)

A paddle type micromanometer and a micrometric needle valve were used for measuring low flow rates, low pressure gradients, and extremely small mass differences in the determination of the natural abundance and the isotopic composition of stable isotopes. The micromanometer is based on a movable metallic disk suspended by a quartz fiber. The leaktight chamber allows operations at pressures near atmospheric and at high vacuum. The measurements are made in the same manner as with a galvanometer, determining the angle of deviation. The drum of the needle valve is graduated, making it possible to choose the desired low flow rate with great precision. (TTT)

25674

AN OPTICAL CEMENT FOR SCINTILLATING CRYSTALS. I. Bally and M. Mărculescu. Acad. rep. populare Romîne, Inst. fiz., atomică și Inst. fiz. Studii cercetări fiz. 11, No. 1, 231-2(1960). (In Rumanian)

An optical cement, used for pasting the scintillating crystal of a photomultiplying instrument, was prepared by incorporating polystyrene in phenylcyclohexane, which was obtained by the condensation of cyclohexyl chloride with benzene using AlCl₃ as catalyst. The cement thus obtained is a viscous liquid with an index of refraction of 1.554, which is close to that of the photomultiplying crystals. The absorption coefficient of the cement has a maximum near 350 mμ, dropping rapidly to a low value in the sensitivity region of the photomultiplier. The complete lack of humidity of the mixture makes the cement especially suitable for use with certain inorganic crystals. (TTT)

25675

STABILIZED CURRENT SUPPLY OF AN IRON-FREE β -SPECTROMETER. I. Ringhiopol. *Acad. rep. populare Romine, Inst. fiz., atomică și Inst. fiz. Studii cercetări fiz.* **11**, No. 1, 256-64(1960). (In Rumanian)

In the iron-free β spectrometers, the magnetic fields necessary for focusing the electrons that can have energies in the Mev range are formed by using coils carrying currents of several tens of amperes, requiring a delicate adjustment and a highly stabilized power supply. A satisfactory stabilizing circuitry was developed and tested. At very high currents it was noted that the system had a tendency to yield a reduced current, caused by increased resistance due to the heating effect. (TTT)

25676

THE DETECTION OF TIME-CORRELATED PHOTONS BY A COINCIDENCE COUNTER. R. Q. Twiss and A. G. Little (Commonwealth Scientific and Industrial Research Organization, Melbourne). *Australian J. Phys.* **12**, 77-93(1959) Mar.

The existence of a correlation between the arrival times of photons was confirmed by measurements with a coincidence counter having a resolving time of 3.5×10^{-8} sec in three different experiments. In the first experiment it was found that the number of coincidence counts recorded from two photomultipliers, the apertures of which were optically superimposed, was significantly greater than when the light beams were incoherent. Furthermore, the number of these correlated counts was in satisfactory agreement with that predicted by theory. In the second experiment the change in the number of excess coincidences was measured as the degree of coherence of the light was altered by increasing the apparent separation of the photocathodes. In this case also there was reasonable agreement between theory and experiment. In the final experiment it was shown that there was a significant difference between the number of coincidences observed when the light beams were in identical as opposed to orthogonal polarizations. This last result especially makes it extremely improbable that the correlation could be caused by some spurious effect, such as plasma oscillations in the source, since the light source itself was found to be completely unpolarized. (auth)

25677

ON THE EFFECT OF VARIATIONS IN THE AMBIENT AIR ON THE CALIBRATION AND USE OF IONIZATION DOSE-METERS. G. P. Barnard, G. H. Aston, and A. R. S. Marsh (National Physical Lab., Teddington, Middx., Eng.). *Brit. J. Radiol.* **33**, 644-5(1960) Oct.

The best available correction factor for humidity should be used for primary and secondary radiation standards. The authors have computed humidity correction factors for both the free-air ionization chamber and for the cavity ionization chamber. (C.H.)

25678

BULLETIN OF TECHNICAL INFORMATION NO. 5. NUCLEAR INSTRUMENTATION. *Bull. inform. sci. et tech.* (Paris) No. 41, 28-49(1960) June. (In French)

In the first part of the article the principle characteristics of the standard electronic apparatus are described. In the second part the studies and developments of the Commissariat à l'Énergie Atomique on detectors, normalized functional elements, counting and selecting circuits, personnel detection apparatus, amplifiers, and prospecting apparatus are reviewed. (J.S.R.)

25679

CONTRIBUTION TO THE MEASUREMENT OF THE TIME INTERVAL BETWEEN 10^{-9} AND 10^{-7} SEC: A DIFFER-

ENTIAL COINCIDENCE SELECTOR WITH TIME-AMPLITUDE CONVERSION ADAPTED TO SLOW SCINTILLATORS. Roland Chery. *Compt. rend.* **251**, 694-6 (1960) Aug. 1. (In French)

With pulse spectra from slow scintillators it is difficult to define with precision by classical coincidence methods the simultaneity of two pulses with different amplitudes. The differential coincidence method was applied to the solution of this problem. The principles of the method are shown graphically. The operational scheme of a selector constructed on this principle is given. (J.S.R.)

25680

METHOD FOR THE DISCRIMINATION OF NEUTRONS AND γ RAYS. Georges Ambrosino, Francis Cambou, and Jean-Pierre Crettez. *Compt. rend.* **251**, 703-5(1960) Aug. 1. (In French)

A method permitting the tracing of neutron spectra in the presence of γ rays with the utilization of an anthracene scintillation is described. This method, based only on the discrimination of pulse forms, uses a coincidence between a linear and a selective output. (tr-auth)

25681

PROBLEMS OF RADIATION DETECTION IN THE AREA OF PROTECTION. A. Menoux. *Énergie nucléaire* **2**, 246-9 (1960) July-Aug. (In French)

The characteristics and classification of radiation detection instruments are described. The instruments were designed to assure that the radiation doses received by exposure to external radiation, by external contamination, or by internal contamination do not exceed the maximum admissible values established by the Commission Internationale de Protection contre les Rayonnements. (tr-auth)

25682

THE PALLETRON AS HIGH FREQUENCY MASS SPECTROMETER. H.-B. Valentini (Karl-Marx- Universität, Leipzig). *Exptl. Tech. Physik* **8**, 65-81(1960). (In German)

The proposal by P. Schissels for a high-frequency mass spectrometer to be built on the Pallettron principle was theoretically and experimentally investigated. The resolution possibilities of the harmonic oscillator working as mass filter with respect to the initial energy of the ions, the production of the parabolic axial potential, the stabilization of the ion orbit by means of an axially directed magnetic field, and the difficulties of the ion production were considered. Resonance curves for electrons were plotted with various detection methods. (tr-auth)

25683

A NEW NUCLEAR ELECTRONIC APPARATUS: THE CARBOTRIMETER. Marcel Durand. *Inds. atomiques* **4**, No. 1-2, 121-7(1960). (In French)

The discovery and development of liquid scintillators have permitted the use of a large number of low-energy radioisotopes. The applications of the detection and measurement of low-energy radioisotopes to geology and archeology, biology and medicine, industry, and hydrology and meteorology are briefly reviewed. The carbotrimer, a commercial radiation-detection instrument, is designed for use in this area. Its design is based on the use of two photomultipliers working in coincidence to cut down the background count and on operation at very-low temperatures. The apparatus is described in detail, and the results of performance tests are given. (J.S.R.)

25684

PROCEEDINGS OF THE SEVENTH SCINTILLATION COUNTER SYMPOSIUM, WASHINGTON, D. C., FEBRUARY 25-26, 1960. *IRE Trans. Nuclear Sci.* **NS-7**, No. 2-3, (1960) June-Sept. 207p.

The Proceedings of the Seventh Scintillation Counter Symposium, held in Washington, D. C., on February 25 and 26, 1960, are included in this volume. Thirty-eight of the papers are abstracted separately; three of the papers were previously abstracted for NSA. (M.C.G.)

25685

THE SCINTILLATION PROCESS IN ORGANIC SYSTEMS. J. B. Birks (Univ. of Manchester, Eng.). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 2-11(1960) June-Sept.

The scintillation process in organic crystals and solutions is described, and a mechanism is proposed to account for the origin of the fast and slow scintillation components. The intermolecular energy migration and transfer processes in pure and mixed crystals and in plastic and liquid solutions are discussed quantitatively, and the influence of temperature and thickness on the scintillation and fluorescence properties is considered. Radioactive processes are shown to be important in crystals and in solid solutions. (auth)

25686

THE ORIGIN OF SCINTILLATIONS IN ORGANIC MATERIALS. Warren L. Buck (Argonne National Lab., Ill.). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 11-16(1960) June-Sept.

Calculations of the energy expended by a charged particle in producing optical excitation of molecules of the scintillator indicate the possibility that most of the energy emitted as light during a scintillation may stem, either directly or via intermolecular transfer, from molecules excited in this way. Observations of the slowly decaying components of the emission suggest, however, that these components arise from molecules left in excited states as a result of the process of ion recombination. (auth)

25687

RISE-TIME CHARACTERISTICS OF ORGANIC SOLUTION SCINTILLATORS. D. F. McDonald, B. J. Dunn, and J. V. Braddock (Fordham Univ., New York). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 17-22(1960) June-Sept.

A special demountable cathode-ray tube was designed to produce electron-beam excitation of organic scintillator solutions. Solutions were irradiated through an electron-permeable window. The beam was swept across the window in 0.4×10^{-9} seconds. A 1P28 photomultiplier and traveling-wave oscilloscope was used in recording. About 25,000 Mev of excitation energy was delivered per pulse and pulse oscillograms were free of statistical variations. System response time was due almost wholly to photomultiplier transit-time dispersion. A pure Gaussian form was assumed for the response function of the system in analyzing pulse contours. The time resolution of the system was adequate to permit observation of the dependence of pulse rise times on concentration in solutions of p-terphenyl in toluene and anthracene in benzene. The results were in good agreement with the energy-transfer theory proposed by Kallmann and Furst. (auth)

25688

SCINTILLATION RESPONSE OF ACTIVATED IONIC CRYSTALS TO CHARGED PARTICLES. A. Meyer and R. B. Murray (Oak Ridge National Lab., Tenn.). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 22-5(1960) June-Sept.

Experimental studies of the response of thallium-activated alkali iodides to various charged particles indicate decreasing scintillation efficiency with increasing particle mass and a nonlinearity in pulse height vs. energy for heavier particles. The scintillation efficiency to electrons, however, is found to be anomalously low, less than that to protons and deuterons. An effort is made to syn-

thesize the results of various experiments and to provide a model for understanding the observed behavior. The model adopted treats the formation of energy carriers and the transport of energy by the diffusion of these carriers from the path of the incoming particle to the activator sites. Results of calculations based on this model are found to be generally consistent with experiment. (auth)

25689

CESIUM IODIDE AS A GAMMA RAY SPECTROMETER. C. T. Schmidt (Harshaw Chemical Co., Cleveland). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 25-8(1960) June-Sept.

Thallium-activated cesium iodide is discussed as a γ spectrometer that should have advantages over thallium-activated sodium iodide at high γ -ray energies. Data are presented which were obtained with a 5-in. diameter by $3\frac{1}{2}$ -in. high right cylinder of thallium-activated cesium iodide viewed with a 3-in.-diameter photomultiplier. These data include linearity of response from 80 kev to 7.2 Mev, resolution as a function of γ -ray energy, and photofractions as a function of γ -ray energy for collimated radiation. (auth)

25690

NEW CERIUM ACTIVATED SCINTILLATING GLASSES. Robert J. Ginther (U. S. Naval Research Lab., Washington, D. C.). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 28-31(1960) June-Sept.

The synthesis of cerium-activated scintillating glasses is being continued, and two new types were developed. One of these, a magnesium-aluminum borate, is similar to the alkali borate glasses reported previously and was made in an effort to provide a scintillating glass with the highest possible boron content in which a reasonable pulse height could be retained. Its pulse height with γ excitation is 5.0% of a NaI(Tl) crystal. The second glass developed is a lithium-magnesium-aluminum silicate. This glass has a pulse height 14.0% of the NaI(Tl) crystal and is the most efficient material prepared in this program. Preliminary studies indicate that energy transfer between the base glass and the activator does occur, and that the efficiency of glass scintillators is not limited by the absence of energy transfer. (auth)

25691

HIGH PRESSURE GAS SCINTILLATORS. Charles E. Engelke (Columbia Univ., New York). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 32-5(1960) June-Sept.

Observations of scintillation pulse heights were made at pressures up to 75 atmospheres in xenon and argon, and in mixtures of nitrogen and xenon, nitrogen and argon, and neon and xenon. Diphenyl stilbene was used as a wavelength shifter. The most salient feature is that in all cases pulse height is approximately independent of pressure at pressures over a few atmospheres. The nitrogen-xenon and neon-xenon mixtures were used as neutron detectors via the $N^{14}(n,p)$, $N^{14}(n,\alpha)$, and $Ne^{20}(n,\alpha)$ reactions. The resolutions achieved, particularly in nitrogen-xenon mixtures (pulse height sometimes down to $\frac{1}{40}$ of pure xenon), allowed a good estimate to be made of the number of photons detected per unit energy loss in the scintillator. (auth)

25692

PULSE SHAPE DISCRIMINATION IN A PLASTIC SCINTILLATOR. F. D. Brooks (Atomic Energy Research Establishment, Harwell, Berks, Eng.), R. W. Pringle, and B. L. Funt. IRE Trans. Nuclear Sci. NS-7, No. 2-3, 35-8(1960) June-Sept.

A plastic scintillator was developed which shows a decay time dependent upon energy loss per unit distance, and,

therefore, is suitable for use with pulse-shape discrimination methods. This scintillator was employed in conjunction with an improved discrimination system and the data were analyzed on a two-dimensional analyzer which provided a matrix of 72×64 channels. At a bias level where 99% of the electron scintillations were eliminated, it was possible to obtain almost 100% counting efficiency for recoil protons of 2 Mev, and the scintillator was useful for protons down to 0.5 Mev. The influence of various monomers, polymerization conditions, scintillating solutes, and secondary solvents was investigated, and a preliminary survey of the effects of these variables on pulse-shape discrimination is presented. (auth)

25693**PULSE SHAPE IN SCINTILLATION COUNTERS.**

T. Tanasescu (Joint Inst. for Nuclear Research, Moscow). *IRE Trans. Nuclear Sci.* **NS-7**, No. 2-3, 39-44(1960) June-Sept.

At the output of a scintillation detector, the form of the current and voltage pulses depends on the time characteristics of the scintillation, on the spread of transit time in the photomultiplier, and on the time constant of the photomultiplier output circuit. Equations were derived for this dependence. The front of the voltage pulse and the revolving time of coincidence circuits were also estimated. (M.C.G.)

25694**PROGRESS IN PHOTOMULTIPLIER TUBES, SCINTILLATION INSTRUMENTS AND IMAGE INTENSIFIERS.**

J. Sharpe (E. M. I. Electronics, Ltd., Hayes, Middx., Eng.). *IRE Trans. Nuclear Sci.* **NS-7**, No. 2-3, 44-51(1960) June-Sept.

Recent work at E.M.I. Electronics Ltd. on photomultiplier tubes for H^3 counting and for other specialized purposes, including short resolving time applications is reviewed. Data on spread of parameters for production tubes of various types are also given. Details of health-physics instruments, based on scintillation techniques, are briefly outlined. A new tube designed for these instruments is described. Work on image intensifiers is also in progress. (auth)

25695**MULTIPLIER-PHOTOTUBE DEVELOPMENT PROGRAM AT RCA-LANCASTER.**

R. W. Engstrom and R. M. Matheson (Radio Corp. of America, Lancaster, Penna.). *IRE Trans. Nuclear Sci.* **NS-7**, No. 2-3, 52-7(1960) June-Sept.

A many-phased development program is being carried on at Lancaster to provide special and improved multiplier phototubes for a variety of applications. Special emphasis was given to improving and testing multiplier phototubes for pulse-height resolution. Tubes of different sizes were ruggedized to permit scintillation counting in unusual operating conditions, such as during rocket flight. New electron-optical arrangements in multiplier phototube structures resulted in less transit-time dispersion. Very wide spectral response was obtained by use of the multi-alkali photocathode in a fused silica envelope. Plans for work in the next year include further development of very-high-speed multiplier phototubes capable of pulse rise times in the 10^{-10} -sec range, and further expansion of the Radio Corporation of America line to include tubes of other sizes, tubes with lower dark current, and tubes with extended ultraviolet response. (auth)

25696**INVESTIGATION OF CATHODE UNIFORMITY AND TRANSIT TIME SPREAD OF MULTIPLIER PHOTOTUBES.**

Sydney J. Roth (Allen B. Du Mont Labs., Inc., Clifton, N. J.). *IRE Trans. Nuclear Sci.* **NS-7**, No. 2-3, 57-61(1960) June-Sept.

The investigation of photocathode uniformity using the flying spot scanner technique is enhanced by the addition of a single-line-selector oscilloscope. This instrument permits a detailed study of any portion of the photocathode surface. The results obtained are of assistance in evaluating cathode uniformity per se as well as the efficiency of electron collection. Transit-time spread measurements are determined by using a coincident method of detection employing output signals of opposite polarity. Measurements of transit-time spread are made by comparison with a variable light path used as a time delay. (auth)

25697**THE DEVELOPMENT OF PHOTOMULTIPLIERS FOR SCINTILLATION COUNTING.**

B. R. Linden, F. W. Schenkel, Jr., and P. A. Snell (CBS Labs., Stamford, Conn.). *IRE Trans. Nuclear Sci.* **NS-7**, No. 2-3, 61-5(1960) June-Sept.

The structures and characteristics of the new line of photomultipliers made by CBS Laboratories are described. Some recent results on the investigation of pulse-height shift are also presented. The development of photomultiplier tubes for the detection of low-level radioactivity is discussed. This involves using tube materials with a minimum of radioactive contamination for such applications as whole-body counting. For low-energy nuclear radiation detection a tube was developed which eliminated thermionic emission from the unused portions of the cathode which were deposited on the sidewalls of the tube. (auth)

25698**NEW RUGGED HIGH-TEMPERATURE PHOTOMULTIPLIERS.**

J. P. Causse (Schlumberger Well Surveying Corp., Ridgefield, Conn.). *IRE Trans. Nuclear Sci.* **NS-7**, No. 2-3, 66-71(1960) June-Sept.

A new photomultiplier was designed which, up to temperatures of 150°C , is suitable for scintillation counting of the natural radioactivity of sediments traversed by an oil well. It uses a special head-on photocathode that is a compromise of stability, sensitivity, and noise. The tube envelope is made of a succession of parallel Kovar and glass rings fused together. Venetian-blind dynodes of the Lallemand type are welded to the inner side of the Kovar rings and bleeder resistors to the outer side. This structure combines excellent mechanical properties (ruggedness and freedom from microphonics) with the very high electrical insulation needed, even at elevated temperatures. Taking advantage of the great versatility of the multiplier structure, several other types of tubes were built with conventional photocathodes (S-11 and S-17) and 14 and 18 stages. They are intended for applications requiring good performance associated with ruggedness. (auth)

25699**PHOTOTUBES CAPABLE OF HIGH CURRENT OUTPUT.**

S. F. Essig (International Telephone and Telegraph Corp., Fort Wayne, Ind.). *IRE Trans. Nuclear Sci.* **NS-7**, No. 2-3, 71-3(1960) June-Sept.

A series of phototubes that have large dynamic range and are capable of high current output is described. The tubes, in conjunction with a solid type scintillator, have become largely standard for measurement of high-intensity short-duration γ radiation. Electrical and optical characteristics are given and discussed. Included also is a brief up-to-date history of the development. (auth)

25700**DARK CURRENT IN PHOTOMULTIPLIERS.**

J. A. Baicker

(Radio Corp. of America, Princeton, N. J.). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 74-80(1960) June-Sept.

A study was undertaken to determine the nature of the processes that contribute to dark current in photomultipliers. Extensive measurements were made on a number of production type photomultipliers and on a series of experimental tubes that were designed to minimize leakage and regeneration. Variations in the dark current pulse-height distribution and counting rate with applied voltage, cathode temperature, and residual gas pressure were measured. The experimental method and preliminary results are discussed. (auth)

25701

RESPONSE OF END-WINDOW PHOTOMULTIPLIER TUBES AS A FUNCTION OF TEMPERATURE. R. B. Murray and J. J. Manning (Oak Ridge National Lab., Tenn.). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 80-86(1960) June-Sept.

A study was made of the response of commercial end-window photomultipliers to light of various wavelengths, in the 4000 to 7000 Å interval, as a function of temperature. All tubes studied were of nominal 2-in. diameter, and included various standard tubes made by DuMont and RCA, low-temperature modifications of standard tubes, and the recently developed multialkali-photocathode tubes. Most of the experiments were performed with the tube operating as a multiplier. In a series of auxiliary experiments, the dynode string was shorted to the anode so that the effect of cooling the cathode could be studied separately. In a typical tube the response to blue light increased somewhat with decreasing temperature; whereas, the response to red light decreased rapidly. These effects were associated with changes in the photocathode spectral sensitivity. At low temperatures ($\sim -100^\circ\text{C}$ or below) the response fell sharply for all wavelengths, an effect attributed to the increased resistivity of the semiconducting photocathode. This effect was not observed in tubes that had the photocathode covered with a semitransparent metallic backing. The temperature dependence of spectral sensitivity in multialkali-photocathodes (RCA C-7261) was significantly different from that of a cesium-antimony photocathode. (auth)

25702

A THREE DIMENSIONAL ANALYZER USING DIGITAL RECORDING ON MAGNETIC TAPE. J. R. Bird (Atomic Energy Research Establishment, Harwell, Berks, Eng.), J. R. Waters, and F. H. Wells. IRE Trans. Nuclear Sci. NS-7, No. 2-3, 87-88(1960) June-Sept.

A digital analyzer that records data on a 1-in. magnetic tape was constructed and used for several experiments. Recording was at slow speed and the analysis was made at 100 in./sec. Recorded data were fed into a ferrite core memory, added up, and finally punched out on to paper tape or cards for processing by a computer. Three typical experiments are described which involve pulse-height analysis of scintillation-counter data and neutron time-of-flight information. These were the measurement of fission neutrons from U^{235} , the spectra of neutron-capture γ rays from platinum, and the investigation of pulse-shape discrimination between neutrons and γ rays for a plastic scintillator. Typical three-dimensional models of the data are shown. (auth)

25703

A PORTABLE GAMMA-RAY SPECTROMETER. A. R. Jones (Atomic Energy of Canada, Ltd., Chalk River, Ont.). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 96-101(1960) June-Sept.

The spectrometer is comprised of a single-channel scanning pulse-height analyzer high-voltage supply photomultiplier tube and sodium iodide crystals. The circuits are transistorized and driven from rechargeable batteries. The analyzer contains a linear amplifier, window discriminator, count rate circuit, and miniature recorder. The recorder and window discriminator are driven synchronously to display a spectrum in 12 min. The circuits and their application and performance are discussed. (auth)

25704

UNSCRAMBLING SCINTILLATION SPECTROMETER DATA. Walter R. Burrus (Ohio State Univ., Columbus). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 102-11(1960) June-Sept.

The pulse-height distribution from a scintillation spectrometer may differ considerably from the spectrum of the incident radiation because the radiation may interact in several different ways with the crystal. Statistical variations in the pulses produce an additional distortion. These facts greatly complicate the quantitative analysis of continuous spectra or discrete spectra with more than a few different energies. Although it is not possible to calculate the exact "unscrambled spectrum," it is possible to obtain a "best estimate" of the incident spectrum and to assign meaningful errors to the result. A clarifying point of view based on Fourier techniques is introduced. Methods for numerical calculation are then described. (auth)

25705

PRESENT STATUS OF SCINTILLATION CHAMBERS. George T. Reynolds (Princeton Univ., N. J.). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 115-20(1960) June-Sept.

The advantages of imaging the tracks of high-energy particles in scintillation counters have been noted by nuclear physicists for some years. Recent developments in scintillator techniques and improvements in the image intensifiers resulted in usable systems. The basis for the design of these systems and their specific advantages to high-energy nuclear physics is discussed. Several experimental proposals are described quantitatively to illustrate the advantages and limitations of the technique. Accomplishments of various groups working in this field are summarized. (auth)

25706

PRESENT STATUS OF IMAGE INTENSIFIER SYSTEMS. K. Lande, A. K. Mann, K. Reibel, and D. H. White (Univ. of Pennsylvania, Philadelphia). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 121-6(1960) June-Sept.

In its application to high-energy physics the luminescent chamber image intensifier system holds forth the promise of combining the advantage of visual measuring techniques with the advantage of the high time resolution of electronic counters. To realize this potential, it is necessary that a system satisfy three basic requirements: (1) it should be a competent image-producing device capable of yielding pictures of minimum ionizing particle tracks with small distortion and with sufficient spatial resolution to permit adequate measurements to be made; (2) it should be a gated system with a time resolution of about 1 μsec or less; and (3) it should utilize luminescent chambers large enough to allow useful experiments to be done, which demands high efficiency to the image preserving optical coupling between chamber and intensifier. The extent to which presently existing systems meet these requirements and the improvements likely to be forthcoming from developmental efforts now in progress are discussed. (auth)

25707

WORK AT IMPERIAL COLLEGE ON IMAGE INTENSI-

FIERS WITH TRANSMITTED SECONDARY ELECTRON MULTIPLICATION. W. L. Wilcock, D. L. Emberson, and B. Weekley (Imperial Coll., London). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 126-32(1960) June-Sept.

The construction and properties of some magnetically focused image intensifiers incorporating potassium chloride films as transmitted secondary electron multiplying dynodes are described. Tubes were prepared with five dynodes which gave a total electron multiplication of the order of 3000. Single electrons leaving the cathode of these tubes gave rise to scintillations at the output phosphor with diameters of about 40 μ , which were bright enough to be photographed. (auth)

25708

THE TRANSMISSION SECONDARY EMISSION IMAGE INTENSIFIER AND ITS APPLICATION TO LOW LIGHT LEVEL IMAGING. A. E. Anderson (Westinghouse Research Labs., Pittsburgh). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 133-6(1960) June-Sept.

Performance data on recent 4-stage image intensifiers utilizing transmission secondary electron emission tubes having 1-in. useful diameter are given. At low light levels, viewing with these tubes is photoelectron-noise-limited. These tubes resolve a minimum of 12 line pairs/mm or a total of 300 line pairs across a diameter. Photon gains as high as 20,000 were measured. Application of this intensifier to nuclear track photography is described. (auth)

25709

IMAGE INTENSIFIERS FOR NUCLEAR TRACK IMAGING. R. G. Stoudenheimer, J. C. Moor, and H. L. Palmer (Radio Corp. of America, Lancaster, Penna.). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 136-41(1960) June-Sept.

The electron image converter is now a proven device for amplifying a light image containing only a few photons per resolved picture element. Two- and three-stage electrostatically focused cascaded image converters were made specifically for the purpose of intensifying the tracks of nuclear particles passing through a scintillation chamber. Gains as high as 50 per stage were obtained with an input equivalent to screen background as low as 10^5 photons/cm²/sec (slightly more than 10^4 photoelectrons/cm²/sec). At reduced voltage and gain, backgrounds were equivalent to about 100 electrons/cm²/sec (the level of the thermionic emission). Scintillations of individual electrons were recognized. With a fast (P15) phosphor for the first screen, the microsecond image storage accompanied by microsecond pulsing of the applied voltage across the second stage made possible complete elimination of tube background in photographs of nuclear tracks. (auth)

25710

PRESENT STATUS OF THE CHanneled IMAGE INTENSIFIER. Jay Burns and M. J. Neumann (Univ. of Chicago). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 142-4 (1960) June-Sept.

The channeled electron multiplier in the form suitable for scintillation track imaging is described briefly. The present state of its development is outlined together with current performance data on gain, background, resolution, etc. The course of future developments and performance capabilities are discussed. (auth)

25711

THE OPTICAL COUPLING OF A SCINTILLATION CHAMBER TO AN IMAGE-INTENSIFYING TUBE. R. J. Potter (IBM Research Center, Yorktown Heights, N. Y.) and R. E. Hopkins. IRE Trans. Nuclear Sci. NS-7, No. 2-3, 150-8(1960) June-Sept.

Several methods for coupling a fiber scintillation chamber

to an image-intensifying tube are considered. A high-speed lens was designed to image the ends of a curved fiber bundle on the curved cathode of an image-intensifying tube. The lens covers a 5-in. field at one-to-one magnification, and at a speed of $f/1.5$. The details of this lens design and its expected performance are discussed. The results of a series of experiments on plastic scintillating fibers were used to determine that the internal reflectivity is 0.993 and absorption constant is 0.015 cm^{-1} in the fiber. The data were then used to compute the optical properties of fibers appropriate to a scintillation chamber system. Certain other optical properties of the components were estimated so that three possible optical coupling schemes could be compared in detail. They are: the lens alone, a glass fiber bundle alone, and a combination of the lens and a glass fiber bundle. The lens alone is about half as efficient as either of the other two methods. The numerical aperture and probable transmission properties of each system are outlined. (auth)

25712

SCINTILLATION COUNTERS IN ROCKETS AND SATELLITES. Carl E. McIlwain (State Univ. of Iowa, Iowa City). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 159-64(1960) June-Sept.

The known and conjectured particle populations in space are reviewed. The role of scintillation counters in obtaining the present knowledge and their possible use in extending this knowledge is discussed. The detectors in Satellite 1958 Epsilon (Explorer IV) and an auroral rocket instrumentation are described in detail. (auth)

25713

APPLICATIONS OF LARGE SCINTILLATION DETECTORS TO COSMIC RAY EXPERIMENTS. George W. Clark (Massachusetts Inst. of Tech. Cambridge). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 164-9(1960) June-Sept.

Large scintillation detectors were employed in several areas of cosmic-ray investigation at Massachusetts Institute of Technology, including air-shower studies, μ -meson polarization measurements, μ -meson intensity monitoring, and a search for cosmic γ rays. In all cases the special advantages of the scintillation technique were an essential part of the experimental concepts. The general principles of the design of large detectors are discussed. Descriptions are given of the construction and performance of several detectors with sensitive areas as large as 3.6 m². (auth)

25714

SPACE SCINTILLATOR-DETECTOR DISTINGUISHING BETWEEN PROTONS AND ELECTRONS. S. D. Bloom, R. C. Kaifer, and C. D. Schrader (Univ. of California, Livermore). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 170-4(1960) June-Sept.

A space scintillator detector was designed and tested which met the following requirements: detection and separation of protons with energy 1.5 Mev and electrons with energy 50 kev; power consumption of 350 mw; and weight less than 5 lb. The basic detector consists of a stilbene scintillator on an RCA 6199 photomultiplier (or the C7151C ruggedized model). The electron-proton separation is accomplished through a circuit which makes use of the different light decay times caused by electrons and protons in the scintillator. The entire package including the amplifiers, scalars, and high-voltage supply occupies a space 5 in. in diameter by 10 in. long. The unit was tested for thermal stability and vibrational shock. A second detector, not restricted to the above power and weight requirements, is being developed to obtain pulse-height information as well. (auth)

25715

DESIGN OF A GAMMA-RAY SPECTROMETER USING THE PHOSWITCH TECHNIQUE FOR REJECTION OF CHARGED PARTICLES. Frank C. Jones (Univ. of Chicago). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 175-7(1960) June-Sept.

The "phoswitch" technique may be used to construct a γ spectrometer that will not respond to charged particles. The theory and design of such a device are discussed and some preliminary data on its performance are presented. (auth)

25716

THE DEVELOPMENT OF THE JUNCTION DETECTOR.

J. W. Mayer (Hughes Aircraft Co., Los Angeles). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 178-80(1960) June-Sept.

The use of semiconductor devices as α spectrometers was first demonstrated on gold-germanium surface-barrier diodes. Investigations were made to determine the capability of silicon junctions, both surface-barrier and shallow-diffused, to perform as charged-particle spectrometers. Small shallow-diffused units were made with good resolution and wide depletion regions, but there was evidence of a thin window on the front surface. Large surface barrier units were made with good resolution and no window effect, but they had only relatively narrow depletion regions. (M.C.G.)

25717

SILICON p-n JUNCTION RADIATION DETECTORS. G. L. Miller (Brookhaven National Lab., Upton, N. Y.). W. L. Brown, P. F. Donovan, and I. M. Mackintosh. IRE Trans. Nuclear Sci. NS-7, No. 2-3, 185-9(1960) June-Sept.

Silicon p-n junction particle detectors were fabricated by diffusing phosphorus to various depths between 0.1 and 2.0 μ into high resistivity p type silicon. Various base material resistivities were employed, ranging from 100 to 13,000 Ω cm. Diffusions were carried out both by the "gaseous" and the "paint-on" processes. The devices produced ranged in area from 1 mm² to 1 cm², with the majority of detectors having an area of ~ 0.2 cm². Using 5.5 Mev α particles and a 5 \times 5 mm device, the best line width that was obtained was 20 kev. It was found that the 1 cm² devices gave line widths of ~ 50 kev. The effect of the thickness of the n layer forming the front surface of the junction was investigated, and it was shown that 0.1- μ diffusions gave essentially "windowless" detectors. Other properties examined were space-charge generation of leakage current, charge collection efficiency as a function of bias and incident particle direction, and signal rise time. (auth)

25718

SILICON SURFACE-BARRIER NUCLEAR PARTICLE

SPECTROMETER. J. L. Blankenship and C. J. Borkowski (Oak Ridge National Lab., Tenn.). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 190-5(1960) June-Sept.

Gold-silicon surface-barrier counters that give good resolution at room temperature were made. Counters from 150 ohm-cm material gave 15-kev ($\sim 1/4\%$) resolution for Cm²⁴⁴ (5.801 Mev) and Am²⁴¹ (5.477 Mev) α particles. A large-area 1-cm² counter gave 0.7% resolution for Po²¹⁰ (5.30 Mev) α particles. The detector resolved α -particle groups that were previously unresolved with Frisch-grid pulse-ion chambers. (auth)

25719

SILICON JUNCTIONS AS PARTICLE SPECTROMETERS.

J. M. McKenzie and J. B. S. Waugh (Atomic Energy of Canada, Ltd., Chalk River, Ont.). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 195-9(1960) June-Sept.

Both gold-silicon surface barriers and silicon p-n junctions operated satisfactorily as particle spectrometers.

The use of high-resistivity material gave a depletion region wide enough to stop high-energy protons, α particles, and heavier ions. A resolution of 16 kev (width at half-maximum) for 6.04 Mev α particles was obtained with a junction depletion layer sufficient to stop 10 Mev α particles. With the depletion region very close to the surface, β particles in the range from 10 to several hundred kev were detectable. The pulse amplitude distribution from Co⁵⁷ indicated the presence of the two well-known lines at 115 and 129 kev. An attempt was made to correlate the observed performance with the semiconductor parameters and the diode static characteristics. (auth)

25720

AN ENCAPSULATED SILICON JUNCTION ALPHA-

PARTICLE DETECTOR. P. P. Webb, R. L. Williams, and R. W. Jackson (Radio Corp. of America, Montreal). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 199-201(1960) June-Sept.

The construction of a silicon-diffused junction α detector in a form which allows complete encapsulation and protection of the junction edge and which preserves a good geometry is described. The unit is inherently shielded from electrical pickup, and is shielded from ambient light by a thin metallic film over the sensitive surface. A modified form of the same encapsulation was used for large area units of 2 cm² suitable for contamination monitoring. Measurements of energy resolution and other characteristics are reported for units of sensitive area 5 mm², 20 mm², and 200 mm². (auth)

25721

TRANSISTORS AS HIGH-SPEED LIGHT PULSERS. H. W. Kendall (Stanford Univ., Calif.). IRE Trans. Nuclear Sci. NS-7, No. 2-3, 202-3(1960) June-Sept.

The emission of light from transistor junctions was investigated in order to design a light source readily constructed from commercially available components which would duplicate the light pulse from Cerenkov radiation. Base-emitter and base-collector junctions were operated in avalanche conduction by overdriving the junctions with approximately rectangular pulses of amplitudes up to 350 volts. The rise time of the pulse was about 1 ns (10^{-9} sec). The pulse duration varied from 2.5 to 20 ns. Continued operation for several hours at pulse amplitudes above 50 volts rendered almost all of the base-emitter junctions useless and degraded the performance of the base-collector junctions. A single junction did not furnish enough light to simulate the light output from plastic scintillators, but operation in series or parallel increased the output. (M.C.G.)

25722

MEGAVOLT ELECTRONICS Cerenkov COUPLER FOR THE PRODUCTION OF MILLIMETER AND SUBMILLIMETER WAVES. Paul D. Coleman and Charles Enderby (Univ. of Illinois, Urbana). J. Appl. Phys. 31, 1695-6(1960) Sept.

When a bunched, megavolt electron beam was used, radiation at the watt level was easily produced with a simple dielectric Cerenkov cone that served simultaneously as an energy converter and radiator. Conditions were arranged to couple out all the Cerenkov radiation produced so that an accurate calculation of the power could be made by considering the simple problem of a beam passing through a hole in an infinite dielectric medium. A maximum of 0.3 w was obtained with an average beam current of 0.028 amp. (M.C.G.)

25723

CHARACTERISTICS OF KRYPTON COUNTERS. Tatsusa-

buro Suzuki (Research & Development Inst., Japan), Jiro Yuhara, and Tecchu Majima. *J. Phys. Soc. Japan* **15**, 1702 (1960) Sept. (In English)

The characteristics of a glass wall counter with gold-sputtered cathodes and 0.05 mm ϕ center wires filled with 99.9% krypton gas and pure ethylene as a quenching gas were studied. The characteristics of the counter were found to depend chiefly on the partial pressure and not on percentages of ethylene. At partial pressures of 17.5 to 35 mm Hg for ethylene, the counter gave good plateau curves. Counters of krypton and methane were tested but gave poor results. (M.C.G.)

25724

DOSIMETRY OF IONIZING RADIATION WITH DYE SOLUTIONS. D. Bertram (Zentralinstitut für Kernphysik, Rossendorf, Ger.). *Kernenergie* **3**, 556-8 (1960) June. (In German)

Solutions of dyes in CCl_4 are suitable for γ dosimetry above 200 keV with a precision of 10 to 20%. The indicator is independent of temperatures from 20 to 60°C and doses of 0.6 to 200 r/min. The solutions are very stable thermally, but are sensitive to the effects of light. (tr-auth)

25725

RADIOACTIVE LABELLING OF MEMBRANE FILTERS FOR THE ASSAY OF AIR-BORNE MATERIAL. G. Kubie (Mining Inst., Czechoslovak Academy of Sciences, Prague) and K. Spurný. *Nature* **187**, 930-1 (1960) Sept. 10.

The application of special features of membrane filters in the assay of air-borne material by radioactive thickness gaging is discussed. The filters themselves were converted into the radiation source used, thereby eliminating the effect of filter thickness from measurement. Initial work was performed by adsorbing radioactive nickel or thallium salts from solution upon the filter surface. (M.C.G.)

25726

AUTOMATIC PARTICLE SIZE DETERMINATION FROM MICRORADIOGRAPHS. O. M. Barlow, W. B. Distler, and J. L. Hile (Univ. of California, Livermore). *Nondestructive Testing* **18**, 341-3 (1960) Sept.-Oct.

A method for automatically counting and sorting large numbers of very small particles imbedded in solid plastics or light metals is described. A block of the filled plastic is sliced extremely thin; radiographed in fine detail; the microradiographs are photographed; the detail is enlarged to a fixed magnification; the photoplate is scanned with a light beam; scanning shadows are electronically sorted according to size; and the analyzer indicates how many particles of each size occur in the scanned area. From these numbers, the number of particles present in a given volume may be calculated. The procedure could be applied to sorting particles in liquid suspensions but faster and cheaper commercial methods are available. (B.O.G.)

25727

USES OF SEMICONDUCTOR DETECTORS IN HEALTH-PHYSICS MONITORING. A. R. Jones (Atomic Energy of Canada, Ltd., Chalk River, Ont.). *Nucleonics* **18**, No. 10, 86; 88; 90-1 (1960) Oct.

Semiconductor detectors offer the health physicist a number of advantages: the detecting medium is very dense compared with a gas; the energy expended per ion pair—3.6 eV in Si—is very low; they operate from simple power supplies; and they are rugged and have short response times. The simplest application is to α -contamination monitoring, since α particles are both energetic and easily stopped. To measure β and γ rays, detectors with the thickest depletion layers are needed; in both cases, ionization is caused by electrons that require a stopping length

of ~ 1 mm of silicon. Neutrons can be detected by means of neutron-sensitive coatings such as B^{10} , which when bombarded by a neutron produces a 1.47-MeV α particle of sufficient penetration to be detectable. Higher-purity silicon is needed for all junction applications in health physics, providing thicker depletion layers and smaller capacities. Improvement in pulse size and in detection efficiency could then be attained. (B.O.G.)

25728

DUAL DETECTORS KEY TO RADIOISOTOPE IDENTIFIER. R. W. Tolmie (Atomic Energy of Canada, Ltd., Ottawa). *Nucleonics* **18**, No. 10, 92 (1960) Oct.

A ratio circuit is described which can be used to identify radioisotopes by means of their γ energies. The ratio of counting rates from twin 7-cm \times 1-cm halogen-quenched G-M tubes mounted together in the probe provides the essential measurement. One tube is shielded by 1 cm of lead while the other is not. The idea is that absorption in the shield, and hence relative counting rates, depends on the γ -ray energy. (B.O.G.)

25729

GAGING GAS DENSITY WITH FAST CHARGED PARTICLES. Berthold W. Schumacher (Ontario Research Foundation, Toronto). *Nucleonics* **18**, No. 10, 106; 109-10; 112; 114 (1960) Oct.

Recent studies with charged particles demonstrate that gas densities may be determined continuously under nearly all circumstances. The methods can be extended to record local variations of flow rates, gas composition, and temperature. The most useful means for these purposes are properly adapted β -ray gages. In some instances electron beams from cathode-ray tubes are better; in others, alpha particles. Applications include 15-ft-diameter furnace flames, supersonic gas jets in a rarefied atmosphere, and high-vacuum measurements at pressures below 10^{-6} torr. For these purposes any of several processes that occur when particles pass through a gas may be used, e.g., scattering, energy loss, ionization, or fluorescence. (B.O.G.)

25730

PRECISION MEASUREMENT IN GAMMA-RAY SPECTROSCOPY. G. A. Bartholomew, J. W. Knowles, and G. E. Lee-Whiting (Atomic Energy of Canada Ltd., Chalk River, Ont.). *Repts. Progr. in Phys.* **23**, 453-543 (1960).

Gamma spectrometers suitable for precision measurements (i.e., those capable of an energy resolution exceeding 1% and an energy accuracy better than 0.2%) are discussed according to the γ interaction used (coherent scattering (crystal diffraction), photoelectric effect, Compton effect, and pair production). Leading instruments of each type are described and the energy range, resolution, efficiency function, and precision in energy and intensity measurement are discussed; and, in some cases, ways of improving existing instruments are indicated. The suitability of the various instruments for different applications is considered; and, where more than one type of instrument can be used under identical conditions, attempts are made to compare their relative merits. (auth)

25731

A SEMICONDUCTOR TRANSFORMER OF CONSTANT VOLTAGE FOR SUPPLYING THE CHARGE DEVICE OF THE DK-0.2 DOSIMETER. B. M. Abakumov. *Vestnik Rentgenol. i Radiol.* **35**, No. 3, 58 (1960) May-June. (In Russian)

The design and construction are given of a direct current semi-conductor transformer supplied by a flashlight battery. The battery voltage varies from 3 to 4.6 v. The voltage yield is over 220 v, and current consumption is

45 to 55 ma. The transformer is encased in a plexiglass $70 \times 43 \times 49$ mm container. The resistance is 4.7 megohms. (R.V.J.)

25732

A RADIOMETRIC METHOD FOR MEASURING THE THICKNESS OF COATINGS. T. M. Khrenkova. *Zavodskaya Lab.* 26, 833-5(1960). (In Russian)

Back-scattering of β radiation was used for determining the thickness of coatings on metals. By losing some of their energy, the electrons shift the maximum of the radiation toward the lower energy range compared to the primary radiation. This value of the new maximum E'_{\max} is determined by the empirical equation $E'_{\max} = 0.12 E_m \cdot Z^{0.38}$, where E_m designates the energy maximum of the primary radiation and Z the atomic number of the scattering element. A scintillation counter and an amplitude discriminator were used for the measurements, in which the thickness of ceramic coatings on steel, molybdenum and titanium was determined. The radiation sources, such as Ti^{204} , P^{32} , Y^{90} (in equilibrium with Sr^{90}), Pr^{144} (in equilibrium with Ce^{144}), and Rh^{106} (in equilibrium with Ru^{106}), must be chosen according to the density range of the coating to be measured. (TTT)

25733

A NEW SCHEME OF THE PULSE MASS-SPECTROMETER WITH HIGH RESOLUTION. B. N. Shustrov (Leningrad Inst. of Physics and Tech.). *Zhur. Tekh. Fiz.* 30, 860-4 (1960) July. (In Russian)

Descriptions are given of a resonance magnetic mass spectrometer. The spectrometer is capable of high resolving power with only one ion revolution along the drift orbit, resulting in considerably increased current discharge. The pulsed ion source eliminates incidental peaks for given masses (harmonics). (tr-auth)

25734

THE CONNECTION BETWEEN ENERGY DISTRIBUTION OF ELECTRONS AND LINE SHAPE OF MASS-SPECTRUM FOR RADIO-FREQUENCY MASS-SPECTROMETER. E. M. Kuchkov (Leningrad Electro-Technical Inst.). *Zhur. Tekh. Fiz.* 30, 948-53(1960) Aug. (In Russian)

The mass spectrum line shape for a radio-frequency mass spectrometer was calculated using the known function for ion energy distributions. (tr-auth)

25735

QUANTUM MECHANICAL AMPLIFIERS. W. E. Lamb, Jr. (Oxford Univ.). p.435-83 of "Lectures in Theoretical Physics. Volume II." Wesley E. Brittin and B. W. Downs, eds. New York, Interscience Publishers, Inc., 1960.

The theory underlying the operation of microwave, quantum mechanical amplifiers is discussed. Such an amplifier is called a MASER, after the phrase describing its function: Microwave Amplification by Stimulated Emission of Radiation. Approximately one-third of the subject matter is devoted to a discussion of those aspects of radiation theory which are relevant to a description of maser operation, and the remainder is devoted to a discussion of masers themselves. The topics discussed are classical and quantum theories of emission and absorption, two-level theory-coherent excitation and thermodynamics, the first working maser, small and strong signal theories, the maser as an amplifier, and three-level masers. (B.O.G.)

25736

RADIO-ACTIVE GAUGING TEMPERATURE COMPENSATOR SYSTEM. (to Foxboro Co.). British Patent 843,425. Aug. 4, 1960.

Radioactive gages for gaging sheet materials usually have reference units for balancing out temperature and

pressure effects on their measuring units. A problem, however, arises in that a temperature change that is effective immediately in the measuring unit may not make itself felt for some time in the reference unit, owing to its being housed. This problem is solved for beta gages by adding a temperature-compensator system comprising a Wheatstone bridge that contains an internal temperature-responsive reference bulb of the resistance type. The function of the system is to detect temperature departures from a pre-set temperature relation between the measuring and reference units and to set up a signal equal to and opposite to that resulting from a temperature change. (D.L.C.)

25737

IMPROVEMENTS RELATING TO ELECTRICAL WAVEGUIDES. George William Buckley (to Metropolitan-Vickers Electrical Co., Ltd.). British Patent 846,900. Aug. 31, 1960.

A waveguide with a sealing window is designed, comprising simply a length of waveguide of circular cross section with a transverse dielectric seal connecting two lengths of waveguide of elliptical cross section to form elbows. The elliptical waveguide lengths may be either perpendicular or parallel to each other; in the latter case, they are displaced laterally. An embodiment of the design with a klystron is shown. The advantages of this design are that the window has a maximum transmission and minimum reflection of energy and that, in electron bombardment of targets, the window can seal off the evacuated apparatus without danger from x rays emitted from the target. (D.L.C.)

25738

IMPROVEMENTS RELATING TO RADIATION MONITORS. Max William Jervis (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 847,620. Sept. 14, 1960.

A circuit is given for testing ionization chamber-type radiation detectors, especially those used to monitor reactor radiation and to shut a reactor down if its radiation is excessive. The circuit consists of a resistance connected in series with the polarizing battery and another battery connected in parallel with the resistance. In operation, the second battery is used to form a rectangular voltage pulse on the polarizing voltage, and the response of the chamber to this pulse is checked. (D.L.C.)

25739

IMPROVEMENTS IN OR RELATING TO IONIZATION CHAMBERS. (to Landis and Gyr, A. G.). British Patent 848,145. Sept. 14, 1960.

A controllable ionization chamber design is given which can be used in compensating detection systems for gaging rolled sheets with β radiation and in which the current of the compensating ionization chamber needs to be varied occasionally. Such variation is effected in the controllable chamber by varying the potential of the control electrode. Four possible configurations of the controllable chamber are shown in which the control and opposing electrodes are arranged at angles around the collector electrode, forming an equilateral triangle; parallel to the collector and in the same plane with each other; and in a circle around a cylindrical collector. This controllable chamber is superior to one having a grid as a control electrode in that no region exists in which ion recombination can occur. (D.L.C.)

25740

CAPACITORS. Vernon Thomas, Seymour Howell, and Edward Thornton (to United Kingdom Atomic Energy Authority). British Patent 848,440. Sept. 14, 1960.

A rolled-foil capacitor having a thin insulator of 0.006 to 0.06 in. thickness is designed for the production of high-current discharges with a very small rise time. The capacitor was charged and discharged at a ringing frequency of 2 Mc through a low-inductance switch 5000 times without breakdown. (D.L.C.)

25741

AUTOMATIC COUNTER. H. P. Robinson (to U. S. Atomic Energy Commission). U. S. Patent 2,939,633. June 7, 1960.

An automatic counter of α particle tracks recorded by a sensitive emulsion of a photographic plate is described. The counter includes a source of modulated dark-field illumination for developing light flashes from the recorded particle tracks as the photographic plate is automatically scanned in narrow strips. Photoelectric means convert the light flashes to proportional current pulses for application to an electronic counting circuit. Photoelectric means are further provided for developing a phase reference signal from the photographic plate in such a manner that signals arising from particle tracks not parallel to the edge of the plate are out of phase with the reference signal. The counting circuit includes provision for rejecting the out-of-phase signals resulting from unoriented tracks as well as signals resulting from spurious marks on the plate such as scratches, dust or grain clumpings, etc. The output of the circuit is hence indicative only of the tracks that would be counted by a human operator.

25742

SCINTILLATION SPECTROMETER. P. R. Bell and J. E. Francis (to U. S. Atomic Energy Commission). U. S. Patent 2,942,109. June 21, 1960.

A portable scintillation spectrometer is described which is especially useful in radio-biological studies for determining the uptake and distribution of γ -emitting substances in tissue. The spectrometer includes a collimator having a plurality of apertures that are hexagonal in cross section. Two crystals are provided: one is activated to respond to incident rays from the collimator; the other is not activated and shields the first from external radiation.

25743

TRANSFORMER FOR JOINING UNBALANCED TO BALANCED TRANSMISSION MEANS. B. J. Bittner and R. H. Opperman (to U. S. Atomic Energy Commission). U. S. Patent 2,943,275. June 28, 1960.

An improved transformer is invented for joining an unbalanced transmission means to a balanced transmission means and is useful, for example, in transmitting an electromagnetic signal from a coaxial cable to a balanced dipole antenna.

25744

ION SOURCE. C. W. Blue and J. S. Luce (to U. S. Atomic Energy Commission). U. S. Patent 2,945,972. July 19, 1960.

An ion source is described and comprises an arc discharge parallel to the direction of and inside of a magnetic field, an accelerating electrode surrounding substantially all of the discharge except for ion exit apertures, and means for establishing an electric field between that electrode and the arc discharge, the electric field being oriented at an acute angle to the magnetic field. Ions are drawn through the exit apertures in the accelerating electrode in a direction substantially divergent to the direction of the magnetic field and so will travel in a spiral orbit along the magnetic field such that the ions will not strike the source at any point in their orbit within the magnetic field.

25745

CONTROL FOR ISOTOPE SEPARATING APPARATUS. H. W. Brackney (to U. S. Atomic Energy Commission). U. S. Patent 2,947,867. Aug. 2, 1960.

Improvements in methods and means for controlling the position and condition of the ion beam of calutrons for more efficient operation were developed. These improvements were accomplished by the addition of a new electrode in the receiver adjacent to and on the far side of one of the ion collector pockets, this electrode receiving and metering a small portion of the outer fringe of the ion beam directed to this pocket. More sensitive and accurate control of the focusing of the ion beams may be obtained by maximizing the ratio of the current to the above pocket to the current to the additional electrode.

25746

MAGNETIC GRID. R. F. Post (to U. S. Atomic Energy Commission). U. S. Patent 2,947,902. Aug. 2, 1960.

An electronic grid is designed employing magnetic forces for controlling the passage of charged particles. The grid is particularly applicable to use in gas-filled tubes such as ignitrons, thyratrons, etc., since the magnetic grid action is impartial to the polarity of the charged particles and, accordingly, the sheath effects encountered with electrostatic grids are not present. The grid comprises a conductor having sections spaced apart and extending in substantially opposite directions in the same plane, the ends of the conductor being adapted for connection to a current source.

25747

MASS SPECTROMETER. F. A. White (to U. S. Atomic Energy Commission). U. S. Patent 2,950,388. Aug. 23, 1960.

A mass spectrometer is designed with a first adjustable magnetic field for resolving an ion beam into beams of selected masses, a second adjustable magnetic field for further resolving the ion beam from the first field into beams of selected masses, a thin foil disposed in the path of the beam between the first and second magnets to dissociate molecular ions incident thereon, an electrostatic field for further resolving the ion beam from the second field into beams of selected masses, and a detector disposed adjacent to the electrostatic field to receive the ion beam.

25748

RADIATION WAVE DETECTION. L. F. Wouters (to U. S. Atomic Energy Commission). U. S. Patent 2,951,158. Aug. 30, 1960.

Radiation waves can be detected by simultaneously measuring radiation-wave intensities at a plurality of space-distributed points and producing therefrom a plot of the wave intensity as a function of time. To this end, a detector system is provided which includes a plurality of nuclear radiation intensity detectors spaced at equal radial increments of distance from a source of nuclear radiation. Means are provided to simultaneously sensitize the detectors at the instant a wave of radiation traverses their positions, the detectors producing electrical pulses indicative of wave intensity. The system further includes means for delaying the pulses from the detectors by amounts proportional to the distance of the detectors from the source to provide an indication of radiation-wave intensity as a function of time.

25749

SAMPLING OSCILLOSCOPE. R. M. Sugarman (to U. S. Atomic Energy Commission). U. S. Patent 2,951,181. Aug. 30, 1960.

An oscilloscope is designed for displaying transient

signal waveforms having random time and amplitude distributions. The oscilloscope is a sampling device that selects for display a portion of only those waveforms having a particular range of amplitudes. For this purpose a pulse-height analyzer is provided to screen the pulses. A variable voltage-level shifter and a time-scale ramp-voltage generator take the pulse height relative to the start of the waveform. The variable voltage shifter produces a voltage level raised one step for each sequential signal waveform to be sampled and this results in an unsmear record of input signal waveforms. Appropriate delay devices permit each sample waveform to pass its peak amplitude before the circuit selects it for display.

25750

ZERO-TIME INDICATOR. H. H. Sander (to U. S. Atomic Energy Commission). U. S. Patent 2,951,201. Aug. 30, 1960.

The travel time of a nuclear shock wave from its point of origin to a location can be determined accurately by an apparatus for noting and comparably recording both zero-time, as indicated by the electromagnetic transient associated with the nuclear detonation, and shock wave arrival time.

Materials Testing

25751 APEX-568

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

STRUCTURAL ANALYSIS OF MOLYBDENUM-BASE ALLOYS BY USE OF A MATERIAL CONSTANT AND THE LEAST-SQUARE ERROR. A. L. Ross and B. R. Thompson. Feb. 28, 1957. 25p. Contracts AF33(600)-38062 and AT(11-1)-171. OTS.

A method is developed for the determination of a Larson-Miller Parameter constant for the structural analysis of molybdenum and molybdenum alloys. The method utilizes a least-squares approximation to determine the best polynomial for describing stress-rupture and minimum-creep-rate properties. (C.J.G.)

25752 NAA-SR-5138

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

A TEST CELL FOR EVALUATING THE AIR LEAKAGE OF BUILDING COMPONENTS. L. Baurmash, R. L. Koontz, C. T. Nelson, and F. W. Schlapp. Sept. 15, 1960. 21p. Contract AT-11-1-GEN-8. OTS.

A 10-ft.-diameter steel sphere, which can be used to measure the air-leak-rate of building materials up to a pressure differential of 5 psi, is described. The techniques for mounting specimens in the cell and methods used for determining leakage through specimens are given. (auth)

25753 NGTE-M-257

Gt. Brit. National Gas Turbine Establishment, Farnborough, Hants, England.

A LABORATORY THERMAL SHOCK TEST BASED ON THE USE OF A FLUIDISED BED. J. Northwood and S. W. K. Shaw. Jan. 1956. 29p.

A laboratory test for studying the thermal-shock behavior and assessing the thermal-shock resistance of gas-turbine-blade materials has been developed using a fluidized bed as the cooling medium. The heat-transfer characteristics of fluidized solids were measured, using different bed materials. The most important factors governing the heat transfer to a fluidized bed appear to be the gas flow rate, the particle size, and the thermal properties of the fluidizing gas. Heat-transfer coefficients similar to those calculated

for current gas-turbine blading are obtainable. Preliminary thermal-shock tests from 900 to 1000°C were made on a number of ceramic and cermet compositions and a creep-resistant alloy using a symmetrically tapered disc test-piece. (auth)

25754 SCTM-100-56(51)

Sandia Corp., Albuquerque, N. Mex.

ELECTRICALLY-OPERATED DEVICES FOR RELEASING WEIGHTS USED IN DROP TESTS. A. R. Phillips. May 29, 1956. 11p. OTS.

Drop tests of an 1800-lb weight are being made as a part of the Component Recovery Program. The weight is hoisted by a crane and released. The first release mechanism used consisted of a solenoid-actuated bomb release. A second release mechanism utilizes a connecting link which is shattered by the explosion of an electrically-fired detonator. Scale-model weights are attached to a carriage mounted on the full-scale weight. The model weight is released from the carriage in free fall by electrically vaporizing the attaching wires. The performance of these release mechanisms is described. (auth)

25755 WAL-TR-111/25

Watertown Arsenal Lab., Mass.

DUCTILITY RELATIONSHIPS IN TENSILE TESTING.

Eric B. Kula and Frank R. Larson. Oct. 1957. 30p. DA Project No. 5B93-08-023.

An equation was developed relating elongation and reduction in area. This was compared to published relationships and to experimental results. Several factors of specimen geometry were discussed, such as gage length and taper, which can influence elongation more than reduction in area. It was shown that errors of 15% in elongation may occur when using the standard ASTM tensile specimen. (auth)

25756 WCAP-6014

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

SURVEY AND SELECTED BIBLIOGRAPHY OF REACTOR FUEL ELEMENT ASSAY SYSTEMS. NUCLEAR MATERIALS CONTROL SYSTEM (NMCS). PHASE II. S. L. Ruby and D. G. Gardner. June 10, 1959. 41p. Contract AT(30-1)-2152. OTS.

A bibliography containing 109 references is presented on the non-destructive analysis of irradiated and unirradiated reactor fuel assemblies. A description of the theory of each method, the equipment utilized, and estimates of the precision obtainable are contained. Problems presented by variations in enrichment, alloying, cladding, geometrical arrangement, etc., are discussed. (C.J.G.)

25757 AEC-tr-4242

France. Commissariat à l'Énergie Atomique, Paris.

APPLICATION OF MICROHARDNESS MEASUREMENTS TO THE STUDY OF DIFFUSION ZONES. (Application des Mesures de microdureté à l'étude des Zones de Diffusion). V. Levy. 1959. Translated from report CEA-1317. 15p. JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 11974.

GEOLOGY, MINERALOGY, AND METEOROLOGY

25758 BNL-615

Brookhaven National Lab., Upton, N. Y.

A STUDY OF THE WIND PROFILE IN THE LOWEST 400

FEET OF THE ATMOSPHERE. Progress Report No. 6 [for] January 16, 1960-May 15, 1960. Irving A. Singer and Leo J. Tick. 13p. DA Project No. 3A99-07-001-03. Contract R-65-8-99812 SC-04-91. OTS.

Mathematical models for describing wind profile in the lowest 400 ft of the atmosphere are reviewed. Application of the models was made to the following cases of wind-speed prediction: (1) from wind speed at a reference level by using an unweighted predictor of varying averaging length and relative displacement in time and (2) from components at the reference level by using a simple unweighted predictor or by using the "best possible" linear predictor. (For preceding period see BNL-596.) (C.J.G.)

25759 NP-9142

Sweden. Försvarets Forskningsanstalt, Stockholm. RADIOACTIVE FALL-OUT FROM ATOMIC WEAPON TESTS. B. Aler, R. Björnerstedt, K. Edvarson, and K. Löw. July 17, 1956. 23p.

Radioactive fall-out over Sweden from nuclear weapon tests was measured systematically for several years. The measurements were obtained from samples of precipitation collected in 60-liter glass or polythene bottles through stainless-steel funnels 2 m in diameter with cone angles of 120°. All samples were measured for their total β activity as a function of time. In those cases in which the γ radiation was strong enough, γ -spectrometric measurements were made. The validity of different measurement procedures for the estimation of health hazards was studied. Results of age determinations by means of β -decay measurements were compared with ages attained from γ -spectrometric measurements. The sum of the simultaneous β activity of all samples collected from Apr. 1953 to Mar. 1956 was plotted. Assuming the yield of Sr^{90} to be 4.3%, the fraction of this isotope in each sample was calculated. During 1956 a preliminary investigation of air-borne fission-product activity was undertaken. Soil-plant-animal studies of Sr^{90} distribution and behavior were begun. (M.C.G.)

25760 NP-9167(p.247-54)

Tata Inst. of Fundamental Research, Bombay. DATING OF DEEP SEA SEDIMENTS USING THE COSMIC RAY PRODUCED ISOTOPE Be^{10} . D. P. Kharkar and N. Narasappaya.

The concentration of Be^{10} produced by cosmic radiation in the atmosphere was used to date a deep sea core taken from the Pacific Ocean. The amount of stable Be^9 in each slice of the core remained nearly constant; whereas, the amount of Be^{10} varied and was generally less near the bottom of the core. The results indicated that the average Be^{10} production rate at the present is 2×10^6 atoms/cm² year and the average sedimentation rate is 1.25 mm/10³ year. The residence time of beryllium in the ocean is 50 to 150×10^3 year. (M.C.G.)

25761 NP-9213

Drexel Inst. of Tech., Centerton, N. J. Lab of Climatology. THE CLIMATIC AND HYDROLOGIC FACTORS AFFECTING THE REDISTRIBUTION OF Sr^{90} . Final Technical Report No. 1. J. R. Mather and J. K. Nakamura. June 1960. 155p. Includes Appendixes: I: THE ROLE OF THE WATER BALANCE IN THE REDISTRIBUTION OF STRONTIUM IN THE SOIL. Technical Note No. 1. John R. Mather. (AFOSR-T[N]-60-97). II: EQUATION AND TABLE FOR DETERMINATION OF THE WAVE OF LEACHING IN THE SOIL. Technical Note No. 3. C. W. Thornthwaite and Sally Thornthwaite. (AFOSR-TN-60-875). III: ANNOTATED BIBLIOGRAPHY ON PRECIPITATION CHEMISTRY. Technical Note No. 2. John R. Mather. (AFOSR-

TN-60-876). Project 7776-67702. Contract AF49(638)-409. (AFOSR-TR-60-101).

Based on the results of experiments using different soils and leaching solutions, a mathematical model of leaching was set up which fairly well reproduced the leaching distribution results. An equation and a table for determining the wave of leaching in the soil are contained. The rate of leaching was found to depend on the cation-exchange capacity of the soil and the quantity and chemical composition of the leaching solution. The influence of climate on these three factors was studied. It was found that the climatic water balance provided a reasonable estimation of the quantity of surplus water or leaching solution which is available for redistributing strontium in the soil in any area. Using data on the climatic moisture index on the cation-exchange capacity or clay content of soils, the influence of climate on exchange capacity was studied. Leaching was much more rapid, per unit of surplus water, in dry climates than in moist climates. A bibliography containing 147 abstracts is presented on the chemistry of leaching. (auth)

25762 UCRL-5665(p.140-53)

Schlumberger Well Surveying Corp., Ridgefield, Conn. AN APPLICATION OF A PULSED NEUTRON SOURCE TO OIL-WELL LOGGING. Jay Tittman.

Oil well logging consists of the measurement of physical or chemical properties as a function of depth of earth formations in situ. The application of accelerators to bore-hole neutron logging is discussed in terms of bore-hole constraint problems and pulsed operational behavior. (W.D.M.)

25763 UCRL-5928

California. Univ., Livermore. Lawrence Radiation Lab. NUCLEAR EXPLOSIVES AND MINING COSTS. Fred L. Smith and Thomas R. Young. July 1960. 37p. Contract W-7405-eng-48. OTS.

An interesting application of nuclear energy to mining operations is the proposed use of nuclear explosives to shatter a buried ore body so that the ore may be leached in situ. This method offers intriguing possibilities for profitable mining of low-grade deposits that would not repay the cost of mining by conventional means. Cost estimates indicate that the nuclear method would be less expensive than the presently used block-caving method, especially for very large ore deposits. (auth)

25764

DETERMINATION OF THE ATMOSPHERIC RADON CONCENTRATION BY DETERMINING THE SOLID DAUGHTER PRODUCTS ON FILTERED SAMPLES. A. Iorgulescu. Acad. rep. populare Romîne, Inst. fiz., atomică și Inst. fiz. Studii cercetări fiz. 11, No. 1, 232-5(1960). (In Rumanian)

Tests were performed by filtering a known amount of air and measuring the activity of the aerosols retained; being a gas, the radon passes through the filter, but the solid daughters RaA , RaB , and RaC' are held back on the filter, together with the dust particles. The radon concentration is calculated on the basis of the assumption that the system is in radioactive equilibrium, which is correct under free atmospheric conditions. After taking daily samples at 10 a.m. for 13 months it was established that the radon concentration varies widely between the extremes of 1 and 915×10^{-18} curies/cm³, with an average value of all the daily samples of 110.6×10^{-18} curies/cm³. (TTT)

25765

EMISSION OF NEUTRONS BY ROCKS. G. V. Gorshkov and N. M. Lyatkovskaya (Khlopin Radium Inst., Academy of

Sciences, USSR). *Doklady Akad. Nauk S.S.S.R.* **133**, 92-4 (1960) July 1. (In Russian)

The rate of neutron production in rocks of the earth's crust was calculated, and the specific neutron intensity was estimated on the basis of published data on the rate of neutron production in various materials by cosmic rays at sea level. The data on neutron emission in granite show 0.5 ± 0.35 neutrons per second per ton of granite. Consequently, nuclear reactions in the earth produce about 50 times less neutrons than are produced by cosmic rays at sea level in paraffin. It is postulated that the neutron flux in granite-type rock is about 5 neutrons/cm²/day. (R.V.J.)

25766

GEOCHEMICAL METHODS OF EXPLORING FOR RARE ELEMENTS. E. S. Burkser and B. F. Mitskevich (Inst. of Geological Sciences, Academy of Sciences, Ukrainian SSR) *Dopovidi Akad. Nauk Ukr. R.S.R.* No. 3, 349-52 (1960). (In Ukrainian)

Results are given of studies of the possibility of employing geochemical methods of exploration for concentrations of rare elements—zirconium, beryllium, scandium, lanthanum, yttrium, gallium, and lead. The researches were conducted within the northwestern part of the Ukrainian crystalline shield. On the basis of a study of the mobility of the enumerated rare elements in natural waters, soil, and plant organisms, concrete conclusions are drawn as to the effectiveness of hydrochemical and biogeochemical methods for their exploration in the given territory. (auth)

25767

AIRBORNE RADIOACTIVITY SURVEYS IN GEOLOGIC EXPLORATION. Robert M. Moxham. *Geophysics* **25**, 408-32 (1960) Apr. (GeoScience abstr. **2**, No. 8, (1960) Aug.).

The value of airborne radioactivity surveys in guiding uranium exploration has been well established. Improved circuitry and development of semiquantitative analytical techniques now permit examination of more complex geologic problems. It is shown that the airborne technique can be used in exploration for thorium-bearing heavy mineral deposits and for uraniferous phosphorites. The observed radiation intensity and configuration of the γ radiation field may be used to approximate the equivalent uranium content and extent of the surficial part of such deposits. The equivalent uranium content of infinite sources can probably be determined within a few thousandths of a per cent and the boundaries fixed within a few hundred feet. As the areal extent of the source decreases, the accuracy of the analytical results likewise decreases. (auth)

25768

RADIOMETRICAL ANALYSIS OF ROCKS ACCORDING TO THE SPECTRUM OF GAMMA-RADIATION. S. V. Iokhel'son and E. V. Shitov. *Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz.* No. 1, 55-62 (1959). (GeoScience abstr. **2**, No. 8, (1960) Aug.).

The isotopic composition of a mixture of elements emitting γ rays can be determined by the distribution of the pulse amplitudes on the exit end of a differential γ ray spectrometer provided with an oscillograph. Examples of the use of the suggested arrangement, called radiometric analysis, are given, illustrating the determination of uranium, radium, and thorium content in rocks and ores. The wiring diagram and the basic scheme of the entire installation are given. The results of the radiometric analysis of specimens of rocks are in good agreement with the chemical analyses. The possibilities of application of radiometric analysis are wide, since the method is free of errors that are due to the absorption of external radiation by the specimens.

25769

STUDIES OF SPECTRA OF γ EMITTING MINERAL DEPOSIT COMPOSITION. Sh. D. Fridman (Inst. of Applied Geophysics, Academy of Sciences, USSR). *Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz.* No. 8, 1187-97 (1960) Aug. (In Russian)

Selected stable parameters for the energy spectra between ~ 0.2 and 3.0 Mev of γ emitting and absorbing media are analyzed. Scintillation counter data were studied, and applications of γ spectrometry in prospecting for radioactive minerals and deposits are discussed. The γ spectra detected on the surface of various homogeneous rock deposits with thorium and uranium concentrations of $\sim 10^{-6}$ g/g and potassium concentrations of $\sim 10^{-2}$ g/g are plotted. (R.V.J.)

HEALTH AND SAFETY

25770 A/AC.82/G/L.388

Japan. National Inst. of Radiological Sciences, Chiba and Japan. National Inst. of Health, Tokyo.

CESIUM-137 AND STRONTIUM-90 IN FALLOUT DEPOSITS. Masami Izawa, Hiroyuki Tsubota, Takashi Nagai, Atsushi Kasai, Masanori Hayashi, and Yoko Ajiki. May 1960. 4p.

Data are presented and discussed from measurements of fall-out and rainfall from August 1957 to August 1959. The Cs^{137}/Sr^{90} ratios found are compared with other data. (T.R.H.)

25771 A/AC.82/G/R.239

Poland. Krajowy Komitet Ochrony Radiologicznej, Warsaw. MEASUREMENTS OF RADIOACTIVE FALL-OUT AND AIRBORNE RADIOACTIVITY IN WARSAW AND CRACOW DURING THE YEAR 1957. 1958. 39p.

Movements of radioactive fall-out and precipitates in river and ground water were measured in Poland during 1957. The data were collected by four stations located in Kraków, Warsaw-Zerań, Legionowo, and Gdynia. These stations carried out their measurements independently of each other, using different methods of collecting and preparing samples and different radiometric devices. All stations, however, calibrated their measuring devices by means of natural potassium. (auth)

25772 AERE-M-524 (2nd Ed.)

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

A SUMMARY OF SOME METHODS OF MEASURING FALL-OUT FROM DISTANT NUCLEAR TEST EXPLOSIONS.

R. N. Crooks, E. M. R. Fisher, and C. J. Fishenden. Aug. 1960. 9p. BIS.

Some of the methods used by AERE for the measurement of fall-out are summarized. Rain is collected by funnel and bottle. Airborne radioactivity is sampled by filters at ground level and at various heights up to 15 km. The total beta activity is measured by simple counter arrangements and individual fission products by gamma spectrometry and radiochemistry. (auth)

25773 CF-54-11-186

Oak Ridge National Lab., Tenn.

A STUDY OF THE CONTRIBUTION OF THE RALA PROCESS TO ATMOSPHERIC CONTAMINATION AT ORNL.

R. L. Bradshaw and W. D. Cottrell. Nov. 1, 1954. Decl. Mar. 15, 1960. 54p. Contract W-7405-eng-26. OTS.

Data on the particulate contamination of the atmosphere at the Oak Ridge National Laboratory were correlated with

laboratory processes and reactor operations for the period from Mar. 1949 to June 1954. A significant correlation was found to exist between one of the chemical-separations processes, RaLa, and peaks of particulate activity on the Laboratory area. The RaLa process was monitored during two complete cycles of operation. The contribution of the process to the general atmospheric contamination of the Laboratory area was determined. The activity was identified and its release to the atmosphere was investigated. It was concluded that the major portion of the contaminated RaLa effluent released to the 3039 stack does not fall out or diffuse in the immediate environs, and hence the stack is not the primary means by which RaLa contributes to atmospheric contamination. A serious offender was found to be an underground liquid-waste storage tank, W-9, in the south tank farm. This tank is used to store RaLa wastes and is vented to the atmosphere. Atmospheric contamination in the immediate vicinity of this vent was observed to reach values as high as $2 \times 10^{-5} \mu\text{c/cc}$, beta activity, averaged over a 24-hr period. (auth)

25774 CF-60-6-64

Oak Ridge National Lab., Tenn.
SAFETY, HEALTH PHYSICS, AND OPERATING PROCEDURES FOR CHEMICAL TECHNOLOGY DIVISION BERYLLIUM FACILITY. K. S. Warren and L. M. Ferris.
June 16, 1960. 13p. OTS.

A summary of the safety precautions, operating techniques, and monitoring methods required for efficient use of the Chemical Technology Division Be facility is presented. (auth)

25775 HW-64945

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
RESEARCH AND DEVELOPMENT ACTIVITIES IN THE FIELD OF RADIOLOGICAL SCIENCES, QUARTERLY PROGRESS REPORT, JANUARY-MARCH 1960. Apr. 27, 1960. 37p. Contract AT(45-1)-1350. OTS.

Data are reported from the following studies: the effect of reactor effluent on the development of young salmon; the toxicity of Sr^{90} - Y^{90} orally administered to trout; the pathological effects of various amounts of Sr^{90} orally administered to miniature swine; the efficacy of tourniquets in preventing transfer from plutonium-contaminated wounds in swine; the fetal uptake, internal dosimetry, and transfer of Zn^{65} to colostrum and milk in gestating ewes; the effects of chelating agents on the excretion of plutonium in rats; the effect of chronic ingestion of Y^{90} in rats; the deposition of $\text{Pu}^{239}\text{O}_2$ particles in the lungs of dogs; the effect of tritium and x rays on the growth of yeast cells; and factors affecting the uptake of Sr^{85} , Ca^{45} , and Zn^{65} by plants. Results are reported from studies on the effect of meteorological conditions on particle diffusion and transport, in which ZnS was used as a tracer to distances of 8 to 16 miles from the source. A complete integrated-monitoring-system proposal was written for future development work concerning all types of radiological instrumentation and methods of data obtaining, transmitting, and recording. Data are presented on the diffusion coefficients of Cs^{137} in clinoptilolite from a CsCl solution and the effects of accompanying ion on adsorption of Sr^{85} on calcareous soil. (For preceding period see HW-63643.) (C.H.)

25776 KAPL-A-HP-2(Rev.1)

Knolls Atomic Power Lab., Schenectady, N. Y.
RADIOLOGICAL SERVICES STANDARD PRACTICE MANUAL. J. T. Mahar, R. L. Beebe, and G. W. Gasper.
Aug. 22, 1960. 145p. Contract W-31-109-Eng-52. OTS.
Personnel exposure limits and contamination limits for

material and equipment are given. The operation and description of radiation monitoring equipment are presented. Radiation protection procedures are given for various situations including slave removal from RML cell, entry into RML cells, waste transfer, event of radioactive spill, etc. ICC shipping regulations for radioactive materials are summarized. The KAPL air-monitoring program is outlined; the instruments used in this program are described. (C.J.G.)

25777 NP-9023

Naval Civil Engineering Lab., Port Hueneme, Calif.
PROGRESS IN RADIATION SHIELDING RESEARCH FOR PROTECTIVE SHELTERS. Technical Note N-385. A. B. Chilton. June 23, 1960. 62p.

The status of radiation shielding technology is reviewed, with emphasis placed on protection against radiation from nuclear weapons explosions. Graphs are presented which show radiation penetration for various types of structures. 44 references. (C.J.G.)

25778 NP-9123

Technical Operations, Inc., Burlington, Mass.
MEASUREMENT OF ATTENUATION IN EXISTING STRUCTURES OF RADIATION FROM SIMULATED FALLOUT. Eric T. Clarke, John F. Batter, Jr., and Arthur L. Kaplan. Apr. 27, 1959. 110p. Contract CD-SR-58-66. (TO-B 59-4).

An experimental study was made of the radiation-attenuation characteristics of several structures, including a multistory building, a thick-walled blockhouse, two residence basements, an open hole, and an underground fall-out shelter. The various buildings were surrounded by simulated fall-out consisting of a 200-curie Co^{60} source circulated over the desired area through prelaidd plastic tubing. Radiation reaching points of interest within the structures was integrated by pocket dosimeters and normalized to yield dose rates for specified fall-out density. The equipment designed to simulate the radiation patterns as well as a novel portable charger-reader built to facilitate readout of the 400 pocket dosimeters on station is described. Also included is an account of an experiment investigating the possibility of using 1:12 steel scale models of buildings for similar measurements. Results are given in terms of protection factors provided by some of the structures, as well as by the fall-out shelters erected within some of them. Effectiveness of various countermeasures are evaluated in terms of the reduction in dose rate provided against ground and roof dose contributions. (auth)

25779 NP-9176

Sweden. Försvarets Forskningsanstalt, Stockholm.
SUMMARY REPORT ON UPPER-AIR RADIOACTIVITY MEASUREMENTS, 1956-1960. K. Edvarson, K. Löw, and G. Lindblom. July 1960. 11p.

A short description of methods for sampling and measurement of nuclear-weapons debris in the upper atmosphere and the results of gross-radioactivity measurements for the period 1956-1960 are given. (auth)

25780 TID-8206(Rev.)

Office of Health and Safety, AEC.
A COMPENDIUM OF INFORMATION FOR USE IN CONTROLLING RADIATION EMERGENCIES INCLUDING LECTURE NOTES FROM A TRAINING SESSION AT IDAHO FALLS, IDAHO, FEBRUARY 12-14, 1958. Allan Brodsky and G. Victor Beard, comps. and eds. Sept. 1960. 105p. OTS.

A training course was held to familiarize members of radiological assistance teams from various parts of the

U. S. with the origin and nature of situations that might, by the event of an unusual accident, release radioactive materials to a populated environment. The course consisted of a series of lectures and a tour of some of the radiation monitoring, source handling, and transportation facilities at NRTS. A summary of the lecture material is presented. (W.D.M.)

25781 USNRDL-TR-453

Naval Radiological Defense Lab., San Francisco.
A DISCREPANCY BETWEEN RESULTS OF BIOLOGICAL AND PHYSICAL DOSIMETRY IN A PARTIAL BODY NEUTRON IRRADIATION FACILITY. M. N. Swift and S. T. Taketa. July 26, 1960. 10p.

In earlier studies, whole- and partial-body neutron irradiation of rats was carried out using a neutron-shielding facility in conjunction with the University of California 60" cyclotron. During the course of this work, an increase in neutron flux of the beam was measured in the presence of the shielding apparatus. In the present investigation, this physically measured flux increment was evaluated with a "biological dosimeter." In the presence of the shielding apparatus, the LD₅₀/6 days for whole-body irradiation of mice was increased by 18.5%, and the neutron flux of the beam was increased by 17%. The essential agreement between these figures appears to indicate that the physically measured apparent flux increment associated with the presence of the shield is not biologically effective. Extensive physical dosimetric studies have shown that the increase in neutron flux in the presence of the shield is not accompanied by significant change in neutron spectrum or of relative gamma-ray flux. The reason for the discrepancy between physical and biological estimates of dose under these experimental conditions is not apparent. (auth)

25782 AEC-tr-4227

NEW RULES FOR TRANSPORTING RADIOACTIVE MATERIALS. (Novye Pravila Transportirovaniya Radioaktivnykh Veshchestv). A. Shtan' and N. Leshchinskii. Translated from Atomnaya Energ. 7, 399(1959). 4p. JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 7651.

25783 AEC-tr-4243

RADIOACTIVE DANGERS FROM CONTINUOUS ATOMIC BOMB TESTING. O. I. Lepsunskii. Translated from Atomnaya Energ. 4, 63-70(1958). JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 8271.

25784 IG-Inf-Ser-2

RADIOACTIVITY AND DRINKING WATER SUPPLIES: UNSOLVED LEGAL QUESTIONS. H. Fischerhof. Translated by J. T. Saunders from Atomwirtschaft 3, 379-83 (1958). 12p.

Problems are considered which might result from the radioactive contamination of drinking-water supplies due to reactor operational accident or errors, or possibly through the regular use of radioactive isotopes by industry. The possibility of the stoppage of drinking-water supplies owing to danger of radioactivity is also considered. Topics discussed include danger, responsibility, supervisory duties of the authorities responsible for the supply of drinking water, legal problems involved in establishing the liability for harm caused by drinking contaminated water, and the possibility of claims for damages. It is concluded that special consideration for water supplies should be included in proposed atomic laws. (C.H.)

25785 JPRS-2707(p.56-61)

DOSES OF X-RADIATION TO WHICH PATIENTS AND

MEDICAL PERSONNEL ARE SUBJECTED DURING CARDIAC CATHETERIZATION. K. Dyurchek, F. Minarik, A. Stankovichova, M. Petrashova, and L. Urichek. Translated from Med. Radiol. 4, No. 10, 66-70(1959).

An investigation was conducted to determine the extent of patient exposure occurring during cardiac catheterization and to estimate the distribution of scattered x radiation associated with such operations. It was concluded that although the patient receives large doses of radiation during cardiac catheterization, the doses received by everyone concerned can be reduced by increased external filtration and reduction of the fluoroscopic field. (J.R.D.)

25786 JPRS-3745

SELECTED SOVIET MILITARY TRANSLATIONS NO. 23, CIVIL DEFENSE MANUAL. N. Ivanov. Bud' gotov k PVO, 1959. 34p. LC.

Rules are presented for conduct of school children in response to local anti-aircraft-defense signals, for using individual and collective protective equipment, for rendering medical first aid and preventive measures against infectious diseases, for fire safety, for chemical and radiological decontamination, and for sanitary processing. (W.L.H.)

25787 JPRS-5078(p.154-63)

LABOR CONDITIONS IN CORE SAMPLING OPERATIONS WITH NEUTRON SOURCES. V. I. Prostyakova, R. S. Belova, and I. I. Yankovskii (Yankovskiy). Translated from Med. Radiol. 5, No. 2, 62-6(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 12481.

25788 JPRS-5078(p.164-78)

WORKING CONDITIONS OF PERSONNEL WORKING WITH CLOSED RADIOACTIVE SOURCES IN MEDICAL INSTITUTIONS. T. S. Seletskaya and I. E. (Ye.) Pasynkova. Translated from Med. Radiol. 5, No. 2, 66-72(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 12814.

25789 JPRS-5078(p.179-82)

EXTENSION UNIT FOR A TISS RADIOMETER FOR MEASURING SOFT β -RADIATION. A. F. Sobol' and Yu. V. Seredin (Seredina). Translated from Med. Radiol. 5, No. 2, 72-3(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 12725.

25790 JPRS-2743(p.88-94)

HYGIENIC EVALUATION OF THE WORKING CONDITIONS OF THOSE WORKING WITH CERTAIN RADIOACTIVE MINERALS AND ORE SAMPLES. O. S. Andreeva (Andreyeva). Translated from Med. Radiol. 4, No. 12, 59-63(1959).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 6561.

25791 JPRS-5124(p.140-50)

PROTECTION IN RADIOLOGICAL DEPARTMENTS WORKING WITH ENCLOSED γ -EMITTERS. A. M. Levit. Translated from Med. Radiol. 5, No. 3, 56-61(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 13969.

25792 JPRS-5124(p.193-206)

THE APPLICATION OF RADIOACTIVE INDICATORS FOR HYGIENIC RESEARCH. A. V. Terman. Translated from Med. Radiol. 5, No. 3, 76-9(1960).

The use of radioisotopes in studying air and water move-

ment, ventilation, aerosols, fall-out, and filters is discussed. 29 references. (T.R.H.)

25793 JPRS-5403(p.1-17)

ORGANIZATION OF RADIOLOGICAL CARE OF THE POPULATION. E. I. Vorob'ev (Ye. I. Vorob'yev). Translated from Med. Radiol. 5, No. 5, 3-10(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 20066.

25794 JPRS-5403(p.64-72)

THE INTERCHANGEABILITY OF THE SOURCE OF RADIATION AND THE OBJECT IN RADIOLOGICAL DOSIMETRY. S. N. Ardashnikov and N. S. Chetverikov. Translated from Med. Radiol. 5, No. 5, 29-33(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 20499.

25795 JPRS-5403(p.81-92)

THE CONDITION OF THE NERVOUS SYSTEM OF PERSONS WORKING WITH RADIOACTIVE SUBSTANCES. A. A. Danilin, N. I. Lukash, T. Ya. Malinovskaya, K. V. Skvirskaya, V. D. Serebryannikov, and G. A. Sheshina. Translated from Med. Radiol. 5, No. 5, 37-43(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 20500.

25796

RESEARCH IN THE RADIOACTIVE CONTAMINATION OF THE ENVIRONMENT. Conrad P. Straub (Robert A. Taft Sanitary Engineering Center, Cincinnati). Arch. Environmental Health 1, 302-10(1960) Oct.

Research activities of the Division of Radiological Health, Robert A. Taft Sanitary Engineering Center, Public Health Service, Cincinnati, Ohio, are described. The Center operates three national networks in cooperation with state and municipal agencies. These include the National Air Sampling Network, which comprises 161 stations from which 24-hr samples of air particulates are collected on a statistically random basis at least bi-weekly; the Water Quality Basic Data Network, which collects weekly samples from 50 stations on the principal U. S. streams; and a National Milk Surveillance Network, which provides monthly samples from each of 10 milk sheds. Gross β determinations are made on the air and stream samples; gross α determinations on one-fourth of the stream samples; and specific radionuclide analyses are made on all milk samples. Representative data on the Cincinnati area are included. (C.H.)

25797

THE COMPOSITION OF THE RADIOACTIVE POWDER WHICH FELL ON ROME WITH THE RAIN OF 4-23-58. Giulio Alberti, Carlo Bettinali, Salvatore Santoli, and Franco Salvetti (Comitato Nazionale per le Ricerche Nucleari, Rome). Atti accad. nazl. Lincei. Rend., Classe sci. fis., mat e nat. 27, 388-91(1959) Dec. (In Italian)

On April 23, 1958, along with the rain, a reddish grey powder was precipitated. The powder, when measured with a Geiger counter with mica window, had an activity of 1700 pulses/min/g of powder. No α activity was detected. The results of the radiochemical analysis are tabulated. From the decay curves and from the radiochemical analysis, it was concluded that the radioactivity of the powder was caused by fission products. There was approximately 39 days between the formation of the fission products and the fall-out over Rome. (J.S.R.)

25798

AN IMPROVED RADIUM SAFE. H. P. Webb (Ontario

Cancer Inst., Toronto). Brit. J. Radiol. 33, 654-5(1960) Oct.

The design of a radium safe for the storage of radium is described. (C.H.)

25799

MEASUREMENT OF RADIOACTIVITY OF MILK.

P. Gaglione, A. Malvicini, and L. Vido (Comitato Nazionale per le Ricerche Nucleari, Ispra, Italy). Minerva nucleare 4, 198-202(1960) July-Aug. (In Italian)

A method for the chemical separation from milk of Sr^{90} and Cs^{137} and the measurement of γ and β activity in the samples are described. The results of analyses of samples collected in November 1959 in different places near the Ispra Nuclear Studies Center are reported. The high concentrations found in studies there are probably due to contamination of foodstuffs from the fallout in the spring of 1959. The concentration of Sr^{90} in the examined milk samples was equal to the maximum permissible concentration in drinking water for the general population. (auth)

25800

GENETIC RADIATION DOSE TO POPULATION OF ROME THROUGH X RAY DIAGNOSTICS. Carissimo Blagini, Massimo Barillà, and Arrigo Montanara (Università, Rome). Strahlentherapie 113, 100-9(1960) Sept. (In German)

The results are given from an inquiry carried out in Rome to estimate the genetically significant dose on the gonads following the application of x rays for diagnostic purposes. The practiced method is in general that recommended by the U. N. Scientific Commission for the Effect of Radiation, which was drawn up in New York in 1958. The data were obtained in part by direct methods by means of follow-up research at different places of work, and in part, also, by indirect methods. The limits of the validity of the data were specially reviewed for the dose, the frequency of the single examinations, the age of the radiated persons, and the combined total error. A total charge per person of $\sim 44 \pm 36$ mrem per year was found. Considering that this inquiry was confined to one town, this value appears relatively low. (auth)

25801

CERTAIN HEALTH HAZARDS FROM FISSION PRODUCTS AND FALLOUT. Rolf Björnerstedt. Thesis, Uppsala, University of Uppsala, 1959. 11p.

The origin, transport, and effects of fall-out are reviewed. The biological hazards from fall-out from nuclear weapons tests and nuclear warfare are evaluated. (C.H.)

25802

RADIATION DOSIMETRY. (to General Aniline & Film Corp.). British Patent 839,136. June 29, 1960.

A personnel dosimeter for high-energy ionizing radiations (0 to 450 r), which is energy- or wavelength-independent in the range 0.175 to 2 Mev (0.01 to 0.08 Å wavelength) is described. The dosimeter consists of a circular thallium-activated KI intensifier crystal surrounded by a lead shield and high-speed photographic print-out paper, both encased in a carrying case. The crystal converts high-energy radiation to visible light, which is then recorded by the paper, and the image is compared with a density wedge. The combination of the crystal and paper with a 0.09-in. lead shield gives a flat sensitivity vs. wavelength curve. The paper is ~ 70 times faster than commercial proof paper and hence must be loaded into the dosimeter under a safelight. The intensification produced by the crystal can be further increased by coating it with a light diffusing medium, e.g., magnesium carbonate, which gives a speed increase of 4.6. (D.L.C.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

25803 AD-235365

American Meat Inst. Foundation, Chicago.

A STUDY OF CHEMICAL CHANGES PRODUCED BY HEAT AND BY IRRADIATION IN MEAT AND MEAT FRACTIONS.

Report No. 3 (Progress) [covering] period March 24, 1959-June 23, 1959. W. A. Landmann. 7p. Project No. 7-84-01-002. Contract DA19-129-QM-1293.

Investigation indicated an objectionable odor in phospholipid or steroid fraction of irradiated meat. Color and odor observation of fractions obtained from cooked irradiated meat are reported. (C.H.)

25804 AD-235511

Massachusetts Inst. of Tech., Cambridge.

STUDIES OF BEEF RADIATION FLAVOR USING A CURRENT RADIATION DISTILLATION TECHNIQUE.

Report No. 1 (Progress) [covering] Period May 1, 1959-July 31, 1959. B. E. Proctor. 22p. Project No. 7-84-01-002. Contract DA-19-129-QM-1374.

It was proved that at least one sulfur-containing carbonyl compound is present in a fraction which exhibits the typical irradiated-beef odor, and which was isolated from a distillate obtained by concurrent radiation-distillation at 5 megarad of a slurry of ground beef. Although experimental evidence indicates that this compound may be methional (β -methylmercaptopropionaldehyde), this has not been definitely established. (auth)

25805 AD-235526

Florida State Univ., Tallahassee.

STABILIZING IRRADIATED MEATS AGAINST OXIDATIVE CHANGES DURING STORAGE. Report No. 4 (Progress) [for] July 1, 1959-September 30, 1959. Betty M. Watts. 6p. Project No. 7-84-01-002. Contract DA19-129-QM-1321.

The production of malonaldehyde during the controlled oxidation of pure fatty acids was followed and related to off odor in irradiated meats. Off odor and production of malonaldehyde was investigated in roast beef slices. (auth)

25806 AECL-Y105

Atomic Energy of Canada Ltd. Commercial Products Div., Ottawa.

THE AECL RADIOISOTOPE HANDBOOK. June 1, 1960. 65p.

The products and services of the Commercial Products Division of Atomic Energy of Canada Ltd. are outlined. A variety of general and technical information is presented which is useful to those working with radiation. Topics discussed include fundamentals and definitions, types and characteristics of radiations, nuclear fission and nuclear reactors, radioisotope production, radiation shielding, uses of radioisotopes, Co^{60} information, and units and constants. (C.H.)

25807 LAMS-2445(p.150-1)

Los Alamos Scientific Lab., N. Mex. and Stanford Research Inst., Menlo Park, Calif.

MEASUREMENTS ON IRRADIATED MEAT. M. A. Van Dilla, E. C. Anderson, R. A. Glass, and H. Smith.

Samples of beef irradiated with 12 megarads of 24-Mev electrons on Aug. 7, 1959, were measured with both a liquid scintillation detector and a sodium iodide gamma-ray spectrometer. The principal activity induced by the irradiation was Na^{22} produced at a concentration of about 2×10^{-4} per g per megarad. The gamma-ray spectrum of a typical sample is presented graphically. (C.H.)

25808 NP-9034

Texas Agricultural Experiment Station, College Station.

A LONG RANGE INVESTIGATION OF THE NUTRITION PROPERTIES OF IRRADIATED FOODS. General Progress Report XV [for] September 1959 to March 1960. L. R. Richardson. 24p. Contract DA-49-007-MD-582.

A study was made of congenital blindness in the young from females receiving an irradiated synthetic diet. The over-all data indicate fairly conclusively that blindness was not due to the irradiated food. Vitamin B_6 was determined in processed beef liver, green beans, cabbage, boned chicken, lima beans, and sweet potatoes. The heat-processed foods contained less B_6 than the irradiated, and the irradiated less than the frozen. All foods contained less B_6 after 6 to 8 months storage than after 0 to 4 months storage. Effects of various treatments on vitamin K were inconsistent. Studies on incidence of the hemorrhagic syndrome continued. (T.R.H.)

25809 NP-9035

Texas. Agricultural Experiment Station, College Station.

A LONG-TERM FEEDING STUDY OF IRRADIATED CHICKEN AND GREEN BEANS USING THE RAT AS THE EXPERIMENTAL ANIMAL. Final Report. L. R. Richardson. Mar. 30, 1960. 24p. Contract DA-49-007-MD-582.

The nutritional value of green beans and fresh-boned chicken treated with 2.79 and 5.58 megarads of γ rays was studied. The data taken included weight, weight of organs, hemoglobin, hematocrit, white cells, lymphocytes, and polymorphonuclear neutrophils. The data were analyzed for parents and F_1 and F_2 generations. No significant difference in nutritive value was found. (T.R.H.)

25810 NP-9050

Cornell Univ., Ithaca, N. Y.

FINAL REPORT—PART I. EFFECT OF IONIZED RADIATION ON THE NUTRITIVE VALUE OF FOOD (CHICKEN STEW) AS DETERMINED BY GROWTH, REPRODUCTION, AND LACTATION STUDIES WITH DOGS. C. M. McCay and G. L. Rumsey. Mar. 15, 1960. 7p. Contract DA-49-007-MD-600.

A study was made of the effects of radiation on the nutritive value of chicken stew by feeding to beagle dogs. Hematology and x-ray bone photographs and growth and reproduction studies indicate that irradiated chicken stew is satisfactory in the diet of the dog. (T.R.H.)

25811 NP-9051

Cornell Univ., Ithaca, N. Y.

FINAL REPORT—PART I. EFFECT OF IONIZED RADIATION ON THE NUTRITIVE VALUE OF FOOD (TUNA FISH) AS DETERMINED BY GROWTH, REPRODUCTION, AND LACTATION STUDIES WITH DOGS. C. M. McCay and G. L. Rumsey. Mar. 15, 1960. 7p. Contract DA-49-007-MD-600.

A study was made of the effects of radiation on the nutritive value of tuna fish in the diet of beagle dogs. A study of the data pertaining to hematology, x-ray photographs of the bones, growth, and reproduction indicates that irradiated tuna fish is satisfactory in the diet of a dog. (T.R.H.)

25812 NP-9052

Cornell Univ., Ithaca, N. Y.

FINAL REPORT—PART I. EFFECT OF IONIZED RADIATION ON THE NUTRITIVE VALUE OF FOOD (PORK) AS DETERMINED BY GROWTH, REPRODUCTION, AND LACTATION STUDIES WITH DOGS. C. M. McCay and G. L. Rumsey. Mar. 15, 1960. 7p. Contract DA-49-007-MD-600.

Radiation effects on the nutritive value of pork was studied using beagle dogs. Study of the data including hematology

ogy, x-ray photographs of bones, growth, and reproduction indicated that irradiated pork is a satisfactory food in the diet of the dog. (T.R.H.)

25813 NP-9085

DeBell and Richardson, Inc., Hazardville, Conn.
TO INVESTIGATE MATERIALS FOR CONTAINERS FOR PACKAGING FOODS. Report No. 14 (Final) [for] Period: September 28, 1956 to January 28, 1959. Wesley S. Larson and Armand G. Winfield. Dec. 15, 1959. 89p. Project No. 7-84-01-002. Contract DA-19-129-QM-764.

The summary of an investigation of plastics packaging materials for radiosterilized foods is presented. The findings are tabulated, but individual details are to be found in the monthly reports. A listing of materials and suppliers is given, and an index to the monthly reports is provided. (T.R.H.)

25814 NP-9089

Nuclear Science and Engineering Corp., Pittsburgh.
DEVELOPMENT OF AN ASSAY FOR PROTEOLYTIC ENZYME ACTIVITIES IN IRRADIATED MEATS AND APPLICATION OF THE ASSAY IN HEAT/RADIATION ENZYME INACTIVATION STUDIES. Report No. 3 (Final) [for] Period: June 10, 1958–September 9, 1959. Abraham Edelmann. 24p. Project No. 7-84-01-002. Contract DA-19-129-QM-1211.

Radiotracer assay techniques were investigated as possibly more sensitive for assaying proteolytic enzymes. The basis of a proposed method was the production of an enzymatically catalyzed insoluble anilide. The anilide would be formed from peptide amides and aniline- C^{14} under the influence of extracted muscle tissue cathepsin. Anilide formation could not be induced. (T.R.H.)

25815 NP-9095

Quartermaster Food and Container Inst. for the Armed Forces, Chicago.
HIGH LEVEL RADIATION POLYMERIZATION DOSIMETRY. Report No. 3 (Final)(Revised) [for] Period: March 27, 1959–March 26, 1960. Frank E. Hoecker. 25p. Project No. 7-84-01-002. Contract DA-19-129-qm-1381.

The design and development of a Radiation Polymerization Dosimeter for attachment to food containers for radiosterilization studies is described. The packet of dosimetric liquid and the liquid itself had to be adapted to this application. A hard gelatin capsule was selected because of its commercial availability, radiation stability, and ease of sealing. Extensive tests were run to study various dosimetric liquids, the effects of mixing them, and storage problems. (T.R.H.)

25816 NP-9102

Hygrade Food Products Corp., Indianapolis.
UTILIZATION OF RADIATION FOR QUALITY OF CANNED HAM AND COMMINUTED MEAT PRODUCTS. Report No. 1 (Progress) [for] Period: May 21, 1959–November 21, 1959. V. R. Rupp. 7p. Project No. 7-84-01-002. Contract QM R & D (Natick) No. 124.

The flavor of canned hams irradiated to 0.5 to 4.5 megarad was compared to controls. Those receiving more than 1 megarad were found unacceptable. Keeping qualities were satisfactory. (T.R.H.)

25817 NP-9169

Syracuse Univ., N. Y. Biological Research Labs.
LONG-TERM FEEDING OF IRRADIATED CHICKEN STEW AND COLESLAW TO RATS. Report No. 6 (Progress) [for] September 15, 1959 to March 15, 1960. A. W. Phillips. 6p. Contract DA-49-007-MD-783.

Irradiated chicken stew (2.79 and 5.58 megarads) and

coleslaw (0.279 and 0.558 megarads) were fed to rats for four generations. Growth, food consumption, feed efficiency, reproduction, lactation, and peripheral blood were studied. Reports on 137 animals are given. (T.R.H.)

25818 NP-9170

Auburn Univ., Auburn, Ala.
FINAL REPORT ON HISTOPATHOLOGY OF RATS FED CODFISH AND SWEET POTATOES. Paul M. Newberne. [nd]. 7p. Contract DA-49-007-MD-543.

A résumé is presented of histopathological findings in 142 rats fed irradiated codfish and sweet potatoes. (T.R.H.)

25819 CEA-tr-A-716

L'UTILISATION DES ISOTOPES RADIOACTIFS DANS LA RECHERCHE MÉTALLOGRAPHIQUE. (Use of Radioisotopes in Metallographic Research). K. Sagel. Translated into French from *Métall* 13, 25-30(1959). 29p.

A review is presented of the possibilities of application of radioisotopes in metallographic research. The topics covered are sample preparation, detection methods, structural research, diffusion studies, oxidation studies, friction research, metal-slag reactions, vapor-pressure measurement, and activation analysis. (T.R.H.)

25820 JPRS-3607

PROSPECTS OF USING RADIOACTIVE ISOTOPES AND NUCLEAR RADIATION IN METALLURGY AND OTHER TECHNICAL SCIENCES. A. M. Samarin and M. S. Fomichev. Translated from *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo* No. 6, 121-6(1959). 11p. OTS.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 14, as abstract No. 19368.

25821

ACTUAL PROSPECTIVES FOR THE INDUSTRIAL UTILIZATION OF RADIATION CHEMISTRY. A. Chapiro (Centre National de la Recherche Scientifique, Paris). *Énergie nucléaire* 2, 225-30(1960) July-Aug. (In French)

Radiation chemistry can utilize radiations emitted by fission products, waste products, and nuclear reactors. After an examination of some regions of chemistry where it would be interesting to utilize radiations (initiation of chain reactions, synthesis reactions, and modification of macromolecules and catalysts), the actual accomplishments of radiation chemistry are reviewed. The reticulation of polyethylene by irradiation is already being done on an industrial scale. Radiochemical methods are used semi-industrially for polymerization, chlorination, grafting of plastic materials, and synthesis of phenol. Radiation and classical chemical productions are compared economically. (tr-auth)

25822

INDUSTRIAL TRACER APPLICATIONS IN CANADA. Geoffrey G. Eichholz (Dept. of Mines and Technical Surveys, Ottawa). *Nucleonics* 18, No. 10, 116; 118-20(1960) Oct.

Tracer uses have not grown as rapidly throughout the world as the more sanguine predictions suggested. In contrast to the reluctance of industries to accept tracer techniques, the medical and biological professions in Canada make wide-spread use of radionuclides. Reasons why tracer applications are not more wide-spread are discussed, and areas in which tracer techniques are being utilized are pointed out. Methods by which valuable industrial information can be obtained through the use of tracers are reviewed. The full potential of tracer appli-

cations will not be realized until there is a more realistic approach to the use of radioactive materials in industry. This requires further explanations of commercial benefits and tests feasible under plant conditions. (B.O.G.)

25823

CURRENT STATUS OF APPLICATIONS IN THE PASTEURIZATION OR STERILIZATION OF FOODS BY IONIZING RADIATIONS. H. F. Kraybill (Curtiss-Wright Corp., Princeton, N. J.). *Texas Eng. Expt. Sta. Misc. Publ. E 72-60 34-6* (1960) Apr.

A comprehensive research and development program on radiation preservation of foods has revealed some products having potential for early commercialization. Radiation sterilization of some meats, especially beef, has been somewhat disappointing. Other items such as chicken, fish, and pork products show promise as completely sterile products. Surveys of the food industry have been made on these items but lack of a competitive position, radiation processing costs higher than thermal processing, and lack of Food & Drug clearance at this time have held up an immediate commercial advance in this area. Radiopasteurization currently, however, offers more promise since effect on quality (flavor, texture, and color) is not encountered and processing cost now approaches that of conventional processing methods. Extension of shelf life, by radiopasteurization of fish, chicken, pork, and beef, is ready for industry-wide exploitation when Food & Drug clearance is provided. Elimination of parasites in meat by very-low dose treatment such as trichina in pork and tapeworm in beef has current interest in industry and may be the first industrial application. The wholesomeness clearance studies are progressing successfully with no evidence that would indicate any toxicity prevailing from eating irradiated foods in tests on animals and man. The ultimate development of "ionizing radiation centers" will advance radiation applications in the food industry since appraisal of performance and costs can be more satisfactorily made than in laboratory projects. Reduction in costs of γ radiation sources should also hold much promise for a preferential competitive position for low-dose radiation treatment of meats, fruits, and vegetables. The unique opportunities afforded by radiation processing of foods in underdeveloped countries for reduction in food spoilage and waste and elimination of food poisoning are of current and immediate importance. (auth)

25824

PIERWSZE KRAJOWE SYMPOZJUM POSWIECONE STOSOWANIU IZOTOPOW PROMIENIOTWORCZYCH W TECHNICE, 8-12 CZERWIEC, 1960-ROGOW. (First National Symposium on the Application of Radioisotopes to Technology, 8-12 June, 1960, Rogow). Warsaw, National Council for the Peaceful Uses of Nuclear Energy, 1960. 139p.

The abstracts of papers are grouped according to the following sessions: (a) flow detection of cast metals, weldments, etc., by means of radioisotopic techniques; (b) remote measurement of flow velocity, liquid level, and moisture content; thickness gages; radiation detectors and their specialized circuitry; (c) quality and production control of metals and alloys by radioisotopic methods, including detection of impurities, diffusion studies, corrosion control; researches on the wear of extrusion molds and bearings; (d) geological prospecting with neutron and gamma profiles in test bores, mine shafts and at the surface; (e) radioisotope sources for industry, preparation of carrier-free S^{35} ; (f) design of the physical facilities of hot laboratories, research programs for radioisotopic investigations, special

facilities, protection of personnel; (g) use of radioisotopic and x-ray techniques in the study of complex chemical bonds, hot analytical chemistry, crystallography and metallurgy. (TTT)

25825

CONTAINER-FILLING MACHINES. Richard Harcourt Whiddington (to Unilever, Ltd.). British Patent 846,270. Aug. 31, 1960.

A filling machine incorporating a β source, e.g., ruthenium or strontium, and a radiation detector was invented for accurate on-the-spot measuring of the amounts of powder delivered into containers. The β source is located on the scraper blade of a feed drum which delivers powder from a hopper into chutes and thence into containers; the β radiation is attenuated by the powder layer passing over the blade to a degree depending on the powder thickness and area density. The output of the Geiger counter located just above the blade is then proportional to the weight of powder fed out. With this arrangement and a count rate of 400 cps corresponding to the correct weight of soap powder per container, a variation of 7.5 cps was observed for each $1/16$ -oz variation in weight. Weight control is most accurate when β radiation attenuated by a powder layer of the correct area density is not greater than 5% (preferably 1%) of the radiation with no layer. Modifications of the arrangement are shown for use with non-sticky and sticky powders. (D.L.C.)

ISOTOPE SEPARATION

25826 CF-53-6-241

Oak Ridge National Lab., Tenn.

DETERMINATION OF THE LITHIUM ISOTOPIC SEPARATION FACTOR IN THE DECALSO (ZEOLITE)-SODIUM CHLORIDE SYSTEM. R. F. Sessions, A. H. Kibbey, J. T. Roberts, and R. E. Blanco. June 1, 1953. Decl. June 10, 1960. 39p. Contract W-7405-eng-26. OTS.

Separation of lithium isotopes by selective sorption of the light component on an ion exchanger with a separation factor of 1.022 calculated from the Raleigh equation was reported by Taylor and Urey. Some of these experiments were repeated to evaluate the method. In an approximate duplication of one of these in which LiCl solution was batch extracted by successive equilibrations with Na^+ -form Decalso (hydrated sodium-aluminum silicate-zeolite) failed to show any significant fractionation of the Li^6 - Li^7 isotopes. No definite reasons for the discrepancy were established; however, it was concluded that the separation factor for lithium isotopes in a Decalso system is less than 1.02^+ . Brief consideration was also given to the possibility of enhancing the separation by addition of a versene salt. Data are presented tabularly and graphically. (J.R.D.)

25827 CISE-79

Centro Informazioni Studi Esperienze, Milan.

PROGETTO DI UN IMPIANTO PER L'ARRICCHIMENTO FINALE DI SOLUZIONI ACQUOSE DI D_2O FINO ALLA CONCENTRAZIONE DEL 99.8%. PARTE III. PROGETTO TECNICO. (Design of A Plant for Final Enrichment of Aqueous Solutions of D_2O to a Final Concentration of 99.8%. Part III. Technical Design). S. Finzi, C. Marchetti, R. Renzoni, and M. Silvestri. July 1960. 95p.

The technical design is presented for a plant to produce 99.75% D_2O from a dilute solution. A description is given of the electrolyzers, control and regulation of final concentration, the apparatus used, general arrangement of the plant, and cost of the product. (T.R.H.)

25828 ORNL-2983(p.12-25)

Oak Ridge National Lab., Tenn.

CHEMICAL SEPARATION OF ISOTOPES. D. A. Lee, A. A. Palko, et al.

The influence of various parameters on the separation of lithium isotopes by ion exchange was determined. Studies of vapor pressures, heats of formation, and various other physical properties of the BF_3 -organic complexes were made in an effort to correlate these phenomena with isotopic fractionation factors. The rate of exchange of CO gas with $\text{Fe}(\text{CO})_5$ was found to be immeasurably slow at 25°C in the dark. C^{13} was depleted in CO evolved from $\text{Fe}(\text{CO})_5$ by iodine, and by photodecomposition of the carbonyl. There was no exchange between C^*O and $\text{Mo}(\text{CO})_6$. Pyridine and sec-butylamine show promise as substituents for ammonia in the cuprous ammonium lactate-CO system; other acids may be substituted for the lactic acid. A 10-mm-ID \times 40-cm-long column for distillation of NO was built and operated. Maximum isotopic fractionation was obtained with low boil-up rates and low system pressures. Nitrogen 14/15 separation of 1.28 and oxygen 16/18 separation of 1.41, corresponding to 8.2 and 8.5 stages, were the largest obtained. The addition of LiCl to an aqueous ammonia solution did not affect the nitrogen isotopic-separation factor between ammonia gas and aqueous ammonia. Operation of the Nitrox facility resulted in the separation of 203 g of N^{15} having a purity of 94 to 98% and 11.5 g of N^{15} having a purity greater than 87%. A half time of 420 days at 35°C was observed for the NH_3 exchange between $\text{Co}(\text{NH}_3)_6\text{Cl}_3$ and NH_4OH in aqueous solution. The atoms in N_2 molecules produced by the alkaline hypobromite oxidation of urea were found to be derived from the same urea molecule. Oxygen isotope fractionation between $\text{O}_2(\text{g})$ and cobalt-di(salicylal)ethylenediamine $\cdot \text{O}_2(\text{s})$ was redetermined. The new value of 1.012 confirms the one previously obtained. The temperature dependence of isotope fractionation in the gas-liquid system $\text{CO}_2(\text{g})$ vs. dipropylamine carbamate(l) was measured. The $\text{C}^{12}/\text{C}^{13}$ fractionation varies from 1.0059 at 25°C to 1.0028 at 60°C , with C^{13} enriching in the liquid. The $\text{O}^{16}/\text{O}^{18}$ fractionation varies from 1.0081 at 25°C to 1.0096 at 60°C , with O^{18} enriching in the gas. Revised and additional values for the single-stage fractionation factors of O^{18} for several aliphatic amine carbamates are presented. A cascade to produce 50% O^{17} and 98% O^{18} was designed and fabricated. Installation of the equipment is in progress. Operation is expected to begin during October. Special nonclogging constant-flow leaks were developed to remove liquid and gaseous products from the O^{17} enrichment cascade. Exchange of calcium between calcium amalgam and aqueous calcium formate was found to be rapid. A tentative separation factor is 1.001 per stage per unit mass difference. Infrared and Raman spectral observations and a complete vibrational frequency assignment were made on $\text{N}_2^{16}\text{O}_4$ and $\text{N}_2^{14}\text{O}_4$. Accurate isotopic partition function ratio calculations from spectral data were performed on a number of nitrogen-containing molecules. Raman spectra are reported for $\text{B}^{10}\text{F}_3 \cdot (\text{CH}_3)_2\text{O}$ and $\text{B}^{11}\text{F}_3 \cdot (\text{CH}_3)_2\text{O}$. The Raman spectra of $\text{Zn}(\text{N}^{15}\text{H}_3)_4\text{Br}_2$, $\text{Zn}(\text{ND}_3)_4\text{Br}_2$, and $\text{Zn}(\text{NH}_3)_4\text{Br}_2$ were observed, and the symmetric Zn-N stretching frequencies were compared and were found to be very close to the ratios $1/\sqrt{18} : 1/\sqrt{20} : 1/\sqrt{17}$, as predicted by theory. Mass spectral studies of the cracking pattern of nitrous oxide are reported for all four nitrogen isotopic species. Metastable transitions were observed in the mass spectrum of nitrous oxide, and their existence was demonstrated with the various isotopic species. Pressure dependence studies showed these transitions to be sponta-

neous as well as collision-induced. Routine isotopic mass analyses were performed on samples of BF_3 by peak-height measurements to give separation factors reproducible to about ± 0.002 . Analyses by the dual-collection, ratio technique were performed on samples of NO , N^{15}O , N_2 , O_2 , CO , and CO_2 to give separation factors generally reproducible to better than ± 0.001 . (auth)

25829 ORNL-2993(p.207-8)

Oak Ridge National Lab., Tenn.

OXYGEN-17 SEPARATION PILOT PLANT.

A pilot-plant facility to separate the natural isotopes of oxygen was designed and is now being built in the deep-bay area of Building 4501. The plant is designed to produce about 2 g of 98% O^{18} and 70 mg of 50% O^{17} per day. The ORNL Chemistry Division developed the process and will operate the plant; the Chemical Technology Division assisted in plant equipment design and construction. (auth)

25830 TID-6696

Princeton Univ., N. J. Plastics Lab. and Du Pont de

Nemours (E. I.) & Co. Explosives Dept., Wilmington, Del.

THERMODYNAMICS OF THE HYDROGEN SULFIDE-WATER SYSTEM RELEVANT TO THE DUAL TEMPERATURE PROCESS FOR THE PRODUCTION OF HEAVY WATER. Technical Report 58B. Herbert A. Pohl. July 1, 1960. 28p. DA Project 3-99-15-108. Contracts AT (07-2)-1 and DA-36-039sc-78105. OTS.

Thermodynamic values for the liquid and gaseous phases of $\text{H}_2\text{S}-\text{H}_2\text{O}$ mixtures, including the light and heavy hydrogen compounds, were evaluated relevant to the dual-temperature process for heavy water production. The data were correlated and extended by interpolation or extrapolation generally for the temperature range 0 to 140°C and for pressures up to 300 psi. The data were used to examine the thermal-feedback effects in the process, as a particular example of the behavior of counter-current process thermal effects. (auth)

25831 CEA-tr-R-845

SÉPARATION DES ISOTOPES DU CARBONE ET DE L'OXYDE AU MOYEN DE RECTIFICATION AVEC DU CO DANS UNE COLONNE DE 12 MÈTRES. (Method for Separation of Carbon and Oxygen Isotopes by Distillation of CO in a 12-meter Column). M. V. Tikhomirov and N. N. Tunitskii (Tounitzkt). Translated into French from *Zhur. Priklad. Khim.* 32, 531-6(1959). 15p.

A 12-m distillation column is described which is used for enriching C^{13} and O^{18} in CO. The upper or extraction part is 2 m long by 25 mm in diameter; the bottom or distillation part is 10 m long and is cascaded, with an upper portion 5 m long and 25 mm in diameter and a lower portion 5 m long and 17 mm in diameter. The whole is of stainless steel. A separation coefficient of 67.8 for C^{13} and 23.6 for O^{18} was obtained. Eighty-two g of CO with 30 to 37% C^{13} and 3.5 to 4.2% O^{18} was collected. (T.R.H.)

25832

A CALCULATOR FOR DETERMINING ACTIVITIES OF SPECIMENS FROM THEIR OBSERVED COUNT-RATES. W. E. Liversage (Lambeth Hospital, London). *Acta Radiol.* 54, 153-6(1960) Aug. (In English)

A simple calculator is described which performs the mathematical operations necessary to convert directly into microcuries the observed count-rates in a radioactive specimen. (auth)

25833

SEPARATION OF HEAVY WATER BY MEANS OF A $\text{H}_2\text{S}-\text{H}_2\text{O}$ ISOTOPIC EXCHANGE DUAL TEMPERATURE PROCESS. J. R. Alvarez González, A. María Arcocha,

J. L. Otero de la Gándara, and J. L. Rojas de Diego (Junta de Energía Nuclear, Madrid). Anales real soc. españ. fís. y quím. (Madrid), Ser. B 56, 547-58(1960) May. (In Spanish)

An attempt was made to determine the variables that have influence over the operation of a cascade of water-hydrogen sulfide dual-temperature isotopic interchange. The optimum reflux at different recoveries as well as the number of theoretical plates necessary to achieve concentrations of 2% D₂O employing cascades of various numbers of stages was calculated. In order to estimate the conditions of economic operation, the relation between temperature and pressure was analyzed. (auth)

25834

MODIFICATION IN THE PROCESS FOR THE PRODUCTION OF HEAVY WATER BY ELECTROLYSIS AND THE EXCHANGE REACTION. DECREASE IN THE STEAM CONSUMPTION. Marcos Gispert and José L. Otero (Junta de Energía Nuclear, Madrid). Anales real soc. españ. fís. y quím. (Madrid), Ser. B 56, 559-68(1960) May. (In Spanish)

Different possibilities of reducing the steam consumption on a cascade process with coupled electrolyzers and catalytic reactors for heavy water production are studied. Making use of steam with a natural D₂O concentration, steam consumptions 2 to 4 kg/g D₂O could be obtained with over-all recovery efficiencies between 50 to 60%; the separation factor is 6 at the electrolyzers. (auth)

25835

HEAVY WATER PRODUCTION. E. Roth. Bull. inform. sci. et tech. (Paris) No. 40, 2-3(1960) May. (In French)

The technical and economic bases of the production of heavy water are summarized. The studies made by the Commissariat à l'Énergie Atomique are indicated. (tr-auth)

25836

THE DISTILLATION PILOT PLANT. L. Stouls. Bull. inform. sci. et tech. (Paris) No. 40, 4-10(1960) May. (In French)

The pilot plant at Toulouse for the distillation of liquid hydrogen is described. The plant is fed with a synthetic gas from which the hydrogen is purified, liquefied, and distilled. The product of the fractional distillation is HD, which is catalytically converted into a gaseous mixture containing H₂, HD, and D₂. This mixture is again distilled. The deuterium product, which has a deuterium concentration of 99.98%, is then compressed in bottles or burned to make heavy water. The hydrogen depleted in deuterium is mixed with the products retained during purification to form the synthetic gas, which is then sent to the ammonia production plant. The plant also produces deuterium-free hydrogen and helium. (tr-auth)

25837

WATER DISTILLATION. THE SOULOM PILOT PLANT. B. Lazard. Bull. inform. sci. et tech. (Paris) No. 40, 11-13(1960) May. (In French)

Water distillation was used during the war for the production of heavy water, but at the present time it is not competitive with the H₂S process. However, distillation is an excellent method to further concentrate heavy water obtained by other methods. The pilot plant at Soulom for the production of heavy water by water distillation is described. (tr-auth)

25838

INDUSTRIAL TESTS ON THE PRODUCTION OF HEAVY WATER BY H₂S-H₂O EXCHANGE. B. Lazard and A. Tillo. Bull. inform. sci. et tech. (Paris) No. 40, 14-18(1960) May. (In French)

The principles of the H₂S-H₂O exchange process and the operational problems for the production of heavy water are summarized. The pilot plant and the facility for corrosion studies at Lacq are described. (tr-auth)

25839

THE ANALYTICAL PROBLEMS AND THE PRODUCTION OF HEAVY WATER. G. Nief. Bull. inform. sci. et tech. (Paris) No. 40, 19-23(1960) May. (In French)

The various methods for the isotopic analysis of hydrogen, developed and used at the Commissariat à l'Énergie Atomique, for heavy water production and for the control of heavy water in nuclear reactors are described. For low deuterium concentrations mass spectrometry is used; for high deuterium concentrations infrared absorption is used. (tr-auth)

25840

GENERALITIES ON THE PHYSICAL CHEMISTRY OF THE PROCESSES FOR HEAVY WATER PRODUCTION. G. Dorian. Bull. inform. sci. et tech. (Paris) No. 40, 24-35(1960) May. (In French)

In order to show the basis of the selection of methods for the industrial production of heavy water, the physical chemistry of the reversible processes of isotopic exchange is reviewed. The isotopic separation factors for distillation and chemical exchange and their theoretical and experimental determination are discussed in particular. The kinetics of exchange reactions are also reviewed. (tr-auth)

25841

SEPARATION OF BORON ISOTOPES. IV. THE METHYL SULFIDE-BF₃ SYSTEM. A. A. Palko and J. S. Drury (Oak Ridge National Lab., Tenn.). J. Chem. Phys. 33, 779-81(1960) Sept.

The exchange of boron between BF₃ (gas) and the dimethyl sulfide-BF₃ complex (liquid) was studied from -20 to +26°C. The single stage separation factor changed from 1.056 to 1.031 over this temperature range with B¹⁰ concentrating in the liquid phase. Vapor pressures of dimethyl sulfide and of various mixtures of BF₃ and dimethyl sulfide were determined. ΔH for the reaction BF₃ (gas) + Me₂S (liquid) → BF₃·Me₂S (liquid) was estimated to be -10.1 kcal/mole over the above temperature range. The melting point of the 1:1 complex was -19.6°C. (auth)

25842

CALUTRON RECEIVERS. (to United Kingdom Atomic Energy Authority). British Patent 839,358. June 29, 1960.

A calutron receiver is described in detail for isotope separation, particularly U²³⁵, and comprises a collecting pocket having an opening for admitting one beam component and a deionizing electrode for intercepting a second-beam component. (D.L.C.)

25843

PROCESS OF RECOVERING URANIUM. (to United Kingdom Atomic Energy Authority). British Patent 846,861. Aug. 31, 1960.

A process is given for recovering uranium from calutron pockets and consists of washing the pockets with hot H₂O (for UCl₄) or acid solution (for metallic uranium), adjusting the pH of the resulting solution at 1 to 3, producing ice crystals in the solution, adding H₂O₂, freezing and thawing, and separating the UO₄ precipitate for calcination to UO₃ and conversion to UCl₄. A complete description of the above process (using two calutrons) is given together with flowsheets of all the various steps. (D.L.C.)

25844

IMPROVEMENTS IN OR RELATING TO A METHOD OF INCREASING THE DEUTERIUM CONTENT OF LIQUID

AMMONIA AND/OR HYDROGEN GAS AND APPARATUS THEREFOR. (to Österreichische Stickstoffwerke Aktiengesellschaft). British Patent 847,584. Sept. 7, 1960.

A scheme for increasing the D content of liquid NH_3 and/or H_2 gas is outlined in which H_2 gas and a D-depleted liquid NH_3 containing KNH_2 as catalyst are passed counter-currently through a series of two cold columns and one hot column. The NH_3 is enriched in D in the cold column, while H_2 is enriched in the hot column, and arrangements may be made to draw off enriched NH_3 or H_2 , or both. The working temperatures are limited by the f.p. (-77°C) and the b.p. of liquid NH_3 at the working pressure (up to 1000 atm). An example of the above scheme put into effect is given using a pressure of 300 atm. (D.L.C.)

25845

ION SOURCES. (to United Kingdom Atom. Energy Authority). British Patent 847,604. Sept. 7, 1960.

An ion source of the arc type is designed which furnishes high ion currents on the order of 10 ma, enough for calutron separation of uranium isotopes. It comprises an evacuated chamber, a thermionically emissive cathode, and a tungsten anode so shaped that the amount of uranium supported by it is small enough to prevent appreciable conversion of the tungsten into an alloy with consequent anode melting. (D.L.C.)

MATHEMATICS AND COMPUTERS

25846 ANL-6187

Argonne National Lab., Ill.

INTRODUCTION TO ELECTRONIC ANALOGUE COMPUTING. Lawrence T. Bryant, Louis C. Just, and Gerard S. Pawlicki. July 1960. 82p. Contract W-31-109-eng-38. OTS.

The design, operation, applications, limitations, and programming of an electronic analog computer are described. (C.J.G.)

25847 CF-60-8-10

Oak Ridge National Lab., Tenn.

ADJOINT FLUX COMPUTATION AND OTHER ADDITIONS AND IMPROVEMENTS TO THE EQUIPOISE PROGRAM; THE THREE-DIMENSIONAL PROTOTYPE PROGRAM, WHIRLAWAY. Melvin Tobias and T. B. Fowler. Aug. 10, 1960. 6p. OTS.

The EQUIPOISE program for two-dimensional two-group calculations in R-Z geometry can now be used to compute adjoint fluxes and integrals associated with them. In addition, certain improvements were made to increase convergence rates in one-dimensional problems, to prevent excessive running times and input errors, and to eliminate redundant tape movements. The WHIRLAWAY code for two-group three-dimensional calculations is described. The program was constructed as a prototype for a future code for the IBM-7090. Cartesian co-ordinates are the only geometry, and the maximum number of mesh points are $8 \times 8 \times 8$. The boundary conditions may be either zero flux or zero derivative, and material distributions are arbitrary. The rate of convergence is found to be significantly greater than that found for the analogous problem using a two-dimensional program. (auth)

25848 GEAP-3057

General Electric Co. Vallecitos Lab., San Jose, Calif. FINE, A CROSS SECTION AVERAGER. C. J. Lavios and R. H. Stark. Sept. 10, 1958. 15p. (R58APE7).

FINE is a utility program designed to alleviate the

burden of hand calculations in preparation of nuclear data for multigroup calculations. It averages microscopic cross sections to obtain output cards which serve as input to the VALPROD and FAF codes. FINE is especially useful where it is necessary to account for inelastic scattering. The operating time for a ten-group four-region problem with inelastic scattering is approximately 3 min. (auth)

25849 HMI-B13

Hahn-Meitner-Institut für Kernforschung Berlin.

FACHVORTRÄGE ZUR TAGUNG VOM 9. BIS 11. MAI 1960 NACH DER EINWEIHUNG DES NEUBAUES. (Departmental Statements of the Meeting of May 9-11, 1960 for Dedication of the New Buildings). Aug. 1960. 100p.

The papers presented at the dedication of new buildings of the Hahn-Meitner Institute are given or abstracted. The titles are: Communications Planning and Mathematics, Magnet Layers in Electronic Calculation Installations, Installation of the 2002 Data Processing Equipment in the Siemens Plant, Buildings and Equipment of the Mathematics Sector, Solution of Neutron Diffusion Equations, Equipment of Modern Information Processing Technology for Flight Traffic Systems, Equipment and Work of the Rhein-Ruhr Calculator Center, Importance of Orthogonal-Anisotropic Square Plates in Structural Engineering, Calculation of Moment-effect Field Orthogonal-Anisotropic Square Plates, The Thinking Ability of Digital Computers, Solution of Inhomogeneous Heat Transfer Equations with Temperature-dependent Coefficients, Unstationary Oscillations with Non-periodic Excitation, Critical Rotation Speeds of Large Steam Turbine Plants, Bending in Free Superimposed Ring Plates with Otherwise Free Edges, Heat Engineering Planning of Steam Power Plants, Selection and Organization Program, Tracing for the S 2002, Program Library, Transverse Force Calculations for Slowly Oscillating Slender Rotating Bodies in Supersonic Flight, Calculations of the Exact Potential Streaming for Rotating Bodies in Supersonic Flight, Work at the Kiev Computer Center, One Application of Approximation Theory in Numerical Analysis, Roentgenographic Structure Determination, the Runge-Kutta Process for Systems of Differential Equations, the Adams Process for Systems of Differential Equations—Comparison of Both Processes After Several Thousand Steps, and The Basic Equations of Reactor Technology. (T.R.H.)

25850 LA-2431

Los Alamos Scientific Lab., N. Mex.

A STUDY OF SOLUTION MULTIPLICITY IN SOME PROBLEMS OF MATHEMATICAL PHYSICS. George H. Pimbley. Apr. 12, 1960. 39p. Contract W-7405-eng-36. OTS.

An eigenvalue problem is introduced for a differential equation which contains a nonlinear term with definitely stated properties. It is shown (methods of proof are described) that instead of getting the familiar properties of the eigenvalues and eigenfunctions of classical linear systems, patterns of finite multiplicity of the solutions are obtained. The probable extension of such multiplicity properties to more involved physical problems and their possible practical consequences in steady-state work are discussed. (auth)

25851 LAMS-2452

Los Alamos Scientific Lab., N. Mex.

STABILITY OF DIFFERENCE EQUATIONS; SELECTED TOPICS. Francis H. Harlow. July 28, 1960. 40p. Contract W-7405-eng-36. OTS.

Part I gives a review concerning the stability properties of some simple linear partial difference equations. Part II

contains examples illustrating some properties of typical nonlinear partial difference equations and an analysis for predicting these properties. (auth)

25852 MND-1267

Martin Co. Nuclear Div., Baltimore.

THEORY AND APPLICATION OF THE 3-GROUP CONSTANT PROGRAM. Nuclear Engineering Technical Memorandum No. 16. T. M. Olsen. Mar. 28, 1958. 17p.

An IBM-704 program for computing fast, epithermal, and thermal cross sections is described. For each group, the program calculates a flux-weighted average of the appropriate multigroup cross-section data obtained from Program C-2. An arbitrary set of fluxes was used for the weighing factors. Data on the three-group constants are punched out in the form required by CURE. The program was written using the FORTRAN coding system. (C.J.G.)

25853 MND-1684 (Rev. 1)

Martin Co. [Nuclear Div.], Baltimore.

BASIC NEUTRON CROSS SECTION DATA TAPE WRITER. M. M. Nussbaum and E. A. Schaefer. Dec. 10, 1959. 21p.

An IBM-709 program, BNCSO, which converts one-decimal neutron-cross-section data to binary data tape, is described. The program, which is written in FORTRAN, can handle up to 50 energy groups of absorption, transport, and fission cross sections, number of neutrons released per fission, and transfer coefficients. (C.J.G.)

25854 NP-9152

Naval Civil Engineering Lab., Port Hueneme, Calif.

COMPILATION OF EXPONENTIAL FUNCTIONS FOR ARGUMENTS FROM 2 THROUGH 50. Technical Compilation C-003. Final Report. J. C. LeDoux and L. K. Donovan. July 25, 1960. 109p.

Tables of exponential functions are given which provide arguments from 2.00 to 50.99 for e^{-x} , e^{-x}/x , $E_1(x)$, $F(x)/x$, and $F(x)$. $F(x)$ is defined as $F(x) = \text{Xe}^x E_1(x)$. Values are listed in floating points, retaining eight significant figures throughout. (C.J.G.)

25855 UCRL-6023

California. Univ., Livermore. Lawrence Radiation Lab.

EIGENVALUE ROUTINE. J. R. Matthews. June 1960. 19p. Contract W-7405-eng-48. OTS.

A program is given which forms the product of the two given matrices. The transformation of the product matrix to the form of the companion matrix is carried out by Danielewsky's method, one row at a time. The characteristic equation obtained is reduced by the method of quadratic factors. Preparation of input and console settings is discussed. (W.D.M.)

25856 UCRL-6042

California. Univ., Livermore. Lawrence Radiation Lab.

STABILITY FOR INHOMOGENEOUS DIFFERENCE SCHEMES. T. Seidman. July 13, 1960. 9p. Contract W-7405-eng-48. OTS.

The equivalence theorem of P. Lax is extended to difference schemes for initial-value problems, for linear inhomogeneous PDE with linear inhomogeneous boundary values, and for boundary-value problems. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

25857 GEAP-3395

General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.

A SURVEY OF NEW CADMIUM MATERIALS FOR POSSI-

BLE REACTOR APPLICATION. S. Siegel. Apr. 1, 1960. 23p. Contract AT(04-3)-189. OTS.

A general survey of the literature was made to discover new cadmium-bearing materials for more effective and more economical control rods in nuclear reactors. The fields of chemistry, metallurgy, and ceramics were explored, and several promising materials and/or fabrication techniques are indicated. (auth)

25858 HW-59371 (Rev.)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

THE STABILITY OF THREE BASE METAL THERMOCOUPLES IN HELIUM-CARBON DIOXIDE, CARBON DIOXIDE AND AIR AT 300°C. J. H. Sako. Apr. 14, 1959. 10p. Contract AT(45-1)-1350. OTS.

Sets of chromel-alumel, copper-constantan, and iron-constantan thermocouples were held for extended periods at 300°C in successive atmospheres of 75% He-25% CO₂, in pure CO₂, and in air. No significant drift beyond experimental error inherent in the measuring system occurred during the tests. Procedures and results are included. (J.R.D.)

25859 HW-62543

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

EFFECTS OF REACTOR ENVIRONMENT ON CANDIDATE PRTR GAS LOOP MATERIALS. A. L. Bement, K. R. Wheeler, and M. J. Pessl. Sept. 1, 1959. 13p. Contract AT(45-1)-1350. OTS.

A program to determine the effects of neutron radiation and reactor gaseous atmospheres on the structural integrity of candidate materials for use in the PRTR gas-cooled loop is outlined. Two types of planned irradiations are described, and the compositions of materials to be evaluated are listed. (J.R.D.)

25860 NP-8975

Narmco Industries Inc., San Diego, Calif.

DEVELOPMENT OF EXO-REACTANT INORGANIC ADHESIVE SYSTEM. Quarterly Progress Report No. 3 [for] April 1, 1960-June 30, 1960. William Bassett and Roger A. Long. July 1, 1960. 22p. Contract Noas-60-6061-c.

Reproducibility of the previous developed silver system adhesive was achieved by reduction of CuO content. Bonds of satisfactory quality were produced and lap shear strengths were consistently over 6000 psi. The stainless-steel heat treatment, TH-950, affected the bond quality adversely, which led to erratic lap shear strengths. Attempts to improve honeycomb panel bonding centered about studies on adhesive composition, effect of heating rate on weight of exotherm required for ignition, and ignition in a vacuum or an inert atmosphere. Attempts to adapt the revised silver system to honeycomb bonding were not successful. (For preceding period see NP-8568.) (C.J.G.)

25861 NP-9117

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

PLASTIC AND COMPOSITE MATERIALS USED IN ROCKET MOTORS, NOZZLES AND PRESSURE VESSELS. PART II. George Evans, comp. July 1, 1960. 20p. (SB-60-17(Pt.II))

Sixty-eight references to reports on metallic nozzle erosion containing test comparisons to plastic nozzles are given. (W.D.M.)

25862 ORNL-2973

Oak Ridge National Lab., Tenn.

MOLTEN-SALT REACTOR PROGRAM QUARTERLY

PROGRESS REPORT FOR PERIODS ENDING JANUARY 31 AND APRIL 30, 1960. Sept. 8, 1960. 98p. Contract W-7405-eng-26. OTS.

Engineering and Component Development. Tests of molten-salt-lubricated hydrodynamic bearings continued in bearing-test rigs and in the sump type centrifugal pumps. The small frozen-lead-sealed centrifugal pump has circulated molten salt continuously at 1200°F for 16,500 hr. Molten salt was circulated at 1200°F in the Remote-maintenance Development Facility. Twenty-five forced-circulation corrosion loops were placed in operation in the MSR corrosion program. A frozen-salt-sealed graphite-to-metal joint was tested. The enthalpy of the BULT-14 mixture ($\text{LiF}-\text{BeF}_2-\text{UF}_4-\text{ThF}_4$) was determined for the temperature range 100 to 800°C. The thermal conductivity for an INOR-8 rod specimen was experimentally established up to a temperature of 900°F. The surface tension of a $\text{NaF}-\text{BeF}_2$ mixture was measured for the range 600 to 800°C. Additional data were obtained for heat transfer to BULT-14 flowing within heated Inconel and INOR-8 tubes.

Materials Studies. Examinations of nine INOR-8 thermal-convection loops, which operated with fused fluoride mixtures for one year, were completed. Seven Inconel thermal-convection loops were also examined, all of which showed attack in the form of intergranular voids to depths ranging from 4 to 15 mils. Examinations of four Inconel forced-convection loops, which operated for different periods with fluoride salt of the $\text{LiF}-\text{BeF}-\text{UF}_4$ system, revealed heavy subsurface-void formation in regions where loop wall temperatures exceeded 1200°F. Metallographic examinations were completed on three INOR-8 forced-convection loops which operated with fluoride mixtures for periods of 1 year or longer; with the exception of one loop, negligible attack was found. Chemical and metallographic examinations were carried out to investigate the thin corrosion film which has appeared in a majority of the long-term INOR-8 corrosion loops. The 48% Ti-48% Zr-4% Be alloy was used to braze an assembly of graphite tubes to an INOR-8 header in order to demonstrate the feasibility of fabricating such an assembly. Alloys in the Au-Ni-Ta and Au-Ni-Mo ternary systems, which are resistant to corrosion by molten fluorides and which may be useful in certain applications, are under study for brazing graphite-to-graphite and graphite-to-molybdenum joints. Thirty-one different grades of graphite were tested for their resistance to permeation by molten fluorides in 100-hr screening tests at 1300°F and pressures of 150 psig. Two tests were conducted to remove from graphite the oxygen contamination that causes a portion of the uranium of $\text{LiF}-\text{BeF}_2-\text{UF}_4$ (fuel 130) to precipitate as UO_2 when this fuel is exposed to the graphite at 1300°F in a vacuum. INOR-8 was carburized to a depth of 14 mils while in direct contact for 3400 hr with grade TSF graphite at 1000 psi in $\text{NaF}-\text{ZrF}_4-\text{UF}_4$ (fuel 30) at 1300°F. Three nickel-base brazing alloys showed good corrosion resistance to fuel 130 at 1300°F during a 10,000-hr thermal-convection loop test of INOR-8 joints. According to preliminary checks on phase behavior, the substitution or addition of ZrF_4 in $\text{LiF}-\text{BeF}_2$ fuels containing UF_4 and ThF_4 appears to provide a feasible route to potential improvements in corrosion behavior and perhaps oxide tolerance while at the same time retaining favorable inventories and physical properties. Selective precipitation of oxides continues to appear promising as a means of processing breeder fuels to remove protactinium and uranium from fluoride melts. Solutions of NO_2 in liquid anhydrous hydrogen fluoride appear attractive as an alternative to $\text{HF}-\text{H}_2\text{O}$ solutions for processing MSR fuel salt containing little or no thorium. In a single experi-

ment no protactinium was removed from MSR blanket salt by fluorination at 650°C. (For preceding period see ORNL-2890.) (W.L.H.)

25863 TID-6463

National Carbon Co., Fostoria, Ohio.

FUEL CYCLE DEVELOPMENT PROGRAM MONTHLY NEWSLETTER FOR JULY 1960. R. L. Robinson.

Aug. 23, 1960. 10p. Contract AT(40-1)-2560. OTS.

An experiment was performed to determine if there are substantial differences in fluidity of the molten carbides of uranium and thorium and of thorium-uranium mixtures at 2800°C. The difference between the carbide melts appears slight; however, in a graphite matrix which shrinks during baking, these differences are magnified. In other investigations, development of a spectrophotometric method for uranium determination is reported along with a green-graphitization experiment and UC_2 experimental manufacture. Results of experiments in which graphited UO_2 scrap was purified by ignition to U_3O_8 are tabulated. The investigation of uranium dispersion in extruded fuel elements was continued. A number of rods were extruded and processed from a mixture of cake particles, pitch, and ceramic grade UO_2 . A process flowsheet and results are included. (J.R.D.)

25864 TID-6480

Bureau of Mines. Boulder City Metallurgy Research Lab., Nev.

ELECTROCHEMICAL STUDIES OF HAFNIUM, ZIRCONIUM AND YTTRIUM. Quarterly Progress Report No. 10 [for] January 1, 1960 to March 31, 1960. 5p. Contract AT(11-1)-475. OTS.

An electrolyte was developed which contained soluble hafnium in the form of K_2HfF_6 . Hafnium was substituted for zirconium in the compound K_2ZrF_6 by electrolysis using a hafnium anode. The electrorefining of yttrium in a KCl bath containing YCl_3 was abandoned in favor of a KCl-LiCl eutectic mixture containing YCl_3 . Replacement of the electrolyte resulted from difficulties associated with the steady displacement of potassium for KCl by the yttrium anode. (For preceding period see AECU-4726.) (C.J.G.)

25865 TID-6572

Utah. Univ., Salt Lake City. Inst. for the Study of Rate Processes.

RECRYSTALLIZATION AND SINTERING OF OXIDES. Progress Report [for] September 1, 1959 to August 31, 1960. Aug. 31, 1960. 35p. Project No. 9. Contract AT(11-1)-82. OTS.

Three important problems have come under intensive study during the past year: (1) rate of shrinkage of powder compacts of alumina, (2) electrical conductivity of single-crystal and polycrystalline alumina, and (3) growth of sapphire seeds in sintered alumina. A fourth problem concerning the kinetics of grain growth in sintered magnesia and sintered calcia was exploratory treatment. Increased accuracy of shrinkage measurement has shown areas of divergence and areas of convergence between theory and experiment. Measurement of rates of shrinkage show promise of yielding accurate determinations of self-diffusion constants. Electrical conductivity of alumina in polycrystalline and single-crystal form is electronic and not ionic. All evidences for ionic conductivity can be traced to surface impurities. Leakage through the gaseous atmosphere surrounding the sample is the most serious experimental problem in high-temperature conductivity measurement. Alumina compacts seeded with sapphire crystals show growth that is approximately uniform in all dimensions but is not uniform with respect to time. For a second

reheating the rate of growth is smaller. Magnesia and calcia show continuous grain growth that conforms to the equations utilized to describe the grain growth of metals. (auth)

25866 WADC-TR-59-366(Pt.I)

Chicago. Univ. Chicago Midway Labs..

THERMAL PROTECTION OF STRUCTURAL, PROPULSION, AND TEMPERATURE-SENSITIVE MATERIALS FOR HYPERSONIC AND SPACE FLIGHT. PART I. RELATIVE PERFORMANCE OF ABLATING MATERIALS EXPOSED TO LOW AND HIGH HEAT FLUX ENVIRONMENTS.

Period covered: August, September, and October 1958.

John H. Bonin and Channon F. Price. July 27, 1959. 62p. Project No. 7360. Contract AF33(616)-6006. OTS.

Results are presented of an investigation for which the prime objective was the comparison of the relative performance of ablating materials exposed to thermal environments associated with recoverable-space-capsule trajectories. The experimental equipment used is briefly described, and test results for 19 different test specimens are presented. The data are used to compare the relative performance of the ablating materials with heat sink materials on a weight-per-unit-area basis. (auth)

25867 CEA-tr-A-690

QUELQUES EXEMPLES D'APPLICATION DE NOUVELLES TECHNIQUES MÉTALLOGRAPHIQUES. (Some Examples of Application of New Metallographic Techniques).

L. Koch, G. Hein, and K. Seste. Translated into French from *Metall* 11, 1038-44(1957). 30p.

Recently developed metallographic techniques (using examples) are described. Included are taper sectioning, anodic and chemical polishing, etching, color photography, contact corrosion, phase contrast microscopy, mirror and high-temperature microscopy, roughness measurement by interferometry, and microhardness testing. (T.R.H.)

25868

LARGE TEMPERATURE RANGE ANNEALING. William Primak (Argonne National Lab., Ill.). *J. Appl. Phys.* 31, 1524-33(1960) Sept.

Vand's analysis of distributions in activation energy is re-examined through a new derivation which leads to a better approximation of the activation energy spectrum and which permits a treatment of step annealing data. The cases of distributions in frequency factor and the twofold distributions in activation energy and frequency factor are also treated. (auth)

25869

ETCH PITS IN PYROLYTIC GRAPHITE. Aram Tarpinian and George E. Gazza (Watertown Arsenal Lab., Mass.). *J. Appl. Phys.* 31, 1657-8(1960) Sept.

The observation of etch pits in pyrolytic graphite after ion-bombardment etching is described and their similarity to dislocation etch pits is speculated. Evidence of etch-pit multiplication in the form of slip-line segments and low-angle tilt boundaries is presented. (auth)

25870

DEVELOPMENT OF REFRACTORY METAL SHEET IN THE UNITED STATES. R. I. Jaffee (Battelle Memorial Inst., Columbus, Ohio), W. J. Harris, Jr., and N. E. Promisel. *J. Less-Common Metals* 2, 95-103(1960) Apr.-Aug. (In English)

The new airframe applications for refractory metals in aircrafts, missiles, and space vehicles require sheet primarily. Development of high quality sheet products and components of the four major refractory metals is being accelerated in the United States. Emphasis is being placed on relatively thin gage sheet of normal sizes but with ex-

ceptional surface quality and gage control. Strength appears secondary to fabricability and quality. United States industry is very active in the development of refractory metals and is introducing special mill equipment for their processing. A coordinated refractory metal sheet-rolling program was organized to develop methods for producing advanced refractory metal alloys in sheet form and to provide production quantities of sheet for development of design criteria data and fabricating, joining, and coating components of interest in the new applications. (auth)

25871

ANALYSIS OF RADIOGRAPHIC TECHNIQUES. J. A. Holloway, D. Polansky, and E. L. Criscuolo (U. S. Naval Ordnance Lab., White Oak, Md.). *Nondestructive Testing* 18, 337-40(1960) Sept.-Oct.

An empirical method for determining radiographic technique by means of a time-latitude curve is introduced. The latitude factor, which is the ratio of the maximum exposure time to the minimum exposure time for a given thickness and sensitivity, is presented for steel in the energy range of 140 kvp to 10 Mev. Latitude factors, as high as fourteen, which slowly decrease with increasing thickness were found. The effects of scattered radiation on these curves are discussed. A technique and sensitivity curve for steel at 250 kvp is presented. The data illustrate that with a given energy (250 kvcp) extreme thicknesses of flat-plate steel (> 3 in.) can be radiographed at a 1% sensitivity level. (auth)

25872

IMPROVEMENTS IN OR RELATING TO PROCESSES FOR PURIFYING METALS. Herbert Noel Jones and Robert Lewis Fullarton Boyd (to United Kingdom Atomic Energy Authority). British Patent 838,997. June 22, 1960.

A method and furnace-electron gun apparatus are described for purifying metals by electron bombardment in vacuum so that the metal is melted in two passes. This method of purification is particularly useful for improving the ductility of metals such as V, U, Nb, W, and Mo. (D.L.C.)

25873

PLUTONIUM-URANIUM-TITANIUM ALLOYS. (to U. S. Atomic Energy Commission). British Patent 843,307. Aug. 4, 1960.

Plutonium-uranium-titanium alloys are proposed for use as fast breeder reactor fuel because they have the following advantages: (1) Pu^{239} serves as breeder fuel for fast (epithermal) neutron fluxes; (2) uranium serves to dilute plutonium and thus reduces cooling difficulties without slowing fast neutrons down to a point where they are captured by Pu^{239} . The uranium is converted to plutonium by reactor operation, thus replacing the spent plutonium; and (3) titanium improves the metallurgical properties of plutonium-uranium alloys (fabrication, working, and corrosion resistance) and does not moderate fast neutrons. Such alloys can be made by mixing uranium and plutonium in atomic proportions from 9:1 to 1:1 and adding 15 to 60 (preferably 32 to 42) at. % titanium. The superior properties of these alloys are attributed to the phase having a hexagonal crystal structure and the composition (U, Pu)₂Ti. (D.L.C.)

25874

IMPROVEMENTS IN OR RELATING TO PROCESSES FOR THE PRODUCTION OF METALS AND THEIR ALLOYS. (to Siemens-Planawerke Aktiengesellschaft). British Patent 846,025. Aug. 24, 1960.

A method is outlined for producing actinide metals and their alloys by reducing their halides, usually chlorides,

with reducing metals, e.g., potassium, in the presence of an excess of a volatile metal (zinc, cadmium, and mercury) at temperatures above 360°C in a closed vessel. The function of the volatile metal is to alloy the resulting actinide and form a medium to which a metal to be alloyed with the actinide can be added; the volatile metal may then be evaporated off, leaving the desired alloy in powder or spongy form. As the volatile metal, mercury is excellent for obtaining fine metallic and alloy powders; cadmium is recommended for fissionable metals because of its large neutron capture cross section. The product chloride is usually separated from the reaction mixture before evaporation of the volatile metal. It is often desirable to reduce the melting point of the product chloride, and addition of $MgCl_2$ will accomplish this with NaCl. Applications of the above method are given using UCl_3 reduction and production of uranium-zirconium alloy with 5 wt. % zirconium as examples. This method is suitable for producing actinide alloys with aluminum, titanium, zirconium, etc. (D.L.C.)

25875

SURFACE TREATMENT OF METALS. (to United Kingdom Atomic Energy Authority). British Patent 847,904. Sept. 14, 1960.

Metals above iron in the electromotive series, e.g., uranium, aluminum, magnesium, and zinc, can be prepared for coating in such a way that their surfaces resist attack by aqueous electroplating solutions and adherent coatings can be applied. This preparation consists of dipping the metal in molten $FeCl_3 \cdot 6H_2O$ for 1 to 3 minutes at 50 to 70°C until a black iron film is deposited, rinsing the metal in H_2O , and immersing it in the electroplating bath. Examples of this method are given for a uranium rod and aluminum strip to be coated with nickel. (D.L.C.)

25876

IMPROVEMENTS IN OR RELATING TO ELECTROLYTIC PROCESSES FOR THE REFINEMENT OF METALS. John Edward Antill (to United Kingdom Atomic Energy Authority). British Patent 847,912. Sept. 14, 1960.

An electrolytic cell for metal refinement is designed so that metals such as uranium, thorium, and niobium can be readily purified from metals more noble in character and metal carbides. The cell comprises an anode of the impure metal to be refined; a porous diaphragm of sintered glass, silica, beryllia, or alumina surrounding the anode; and a cathode either of a material to which the refined metal does not adhere (e.g., molybdenum or tungsten) or of the metal being refined. In a second configuration, the cathode, anode, and diaphragm are together surrounded by a porous crucible of the same material as the diaphragm. After refining the crucible is lifted together with the refined metal and allowed to drain, and it is then placed in a furnace to melt the metal. The cell is filled with a molten salt (e.g., a LiCl-KCl eutectic) of a soluble compound of the metal being refined, and electrolysis is begun. The diaphragm stops the impurities but allows the metal ions to pass through to deposit on the cathode. An example of the electrolytic process is given for both configurations using impure uranium (UF_4) as a source of uranium ions and a tungsten cathode; in the first configuration, the original impurities of 200 ppm iron, 12 ppm nickel, 15 ppm manganese, and 1700 ppm carbon were reduced to 7, 1, 1, and 90 ppm, respectively. (D.L.C.)

25877

METHOD OF PROTECTING TANTALUM CRUCIBLES AGAINST REACTION WITH MOLTEN URANIUM. H. M. Feder and N. R. Chellew (to U. S. Atomic Energy Commission). U. S. Patent 2,949,390. Aug. 16, 1960.

Tantalum crucibles against reaction with molten uranium by contacting the surfaces to be protected with metallic boron (as powder, vapor, or suspension in a liquid-volatile-nonreacting medium, such as acetone and petroleum oil) at about 1800°C in vacuum, discontinuing contact with the boron, and heating the crucibles to a temperature of between 1800 and 2000°C, whereby the tantalum boride formed in the first heating step is converted to tantalum monoboride.

25878

REDUCTION OF FLUORIDE TO METAL. O. N. Carlson, F. A. Schmidt, and F. H. Spedding (to U. S. Atomic Energy Commission). U. S. Patent 2,950,962. Aug. 30, 1960.

A process is given for making yttrium metal by reducing yttrium fluoride with calcium plus magnesium. Calcium is added in an excess of from 10 to 20% and magnesium in a quantity to yield a magnesium-yttrium alloy containing from 12 to 25% magnesium when the reaction mass is heated in an inert atmosphere at from 900 to 1100°C, but preferably above the melting point of the alloy. Calcium chloride may be added so as to obtain a less viscous slag containing from 30 to 60% calcium chloride. After removal of the slag the alloy is vacuum-heated at about 1100°C for volatilization of the magnesium and calcium.

25879

ELECTRODEPOSITION OF NEPTUNIUM. G. T. Seaborg and A. C. Wahl (to U. S. Atomic Energy Commission). U. S. Patent 2,951,018. Aug. 30, 1960.

A process of electrodepositing neptunium from solutions is given which comprises conducting the electrodeposition from an absolute alcohol bath containing a neptunium nitrate and lanthanum nitrate at a potential of ~50 volts and a current density of between about 1.8 and 4.7 ma/dm².

25880

METHOD FOR ELECTRODEPOSITING POLONIUM. R. F. Wehrmann (to U. S. Atomic Energy Commission). U. S. Patent 2,951,020. Aug. 30, 1960.

The deposition of a thick uniform layer of polonium metal from aqueous solutions can be carried out by electrolyzing an aqueous solution of 1 N hydrofluoric acid containing about 0.13 curie of polonium per cubic centimeter of solution with platinum electrodes and a current density of about 1.2 ma/cm² of cathode surface.

Corrosion

25881 AERE-R-3257

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE OXIDATION AND CORROSION OF ZIRCONIUM AND ITS ALLOYS. XI. THE OXIDATION KINETICS OF ZIRCONIUM-NIOBIUM BINARY ALLOYS IN STEAM AT 300-500°C. B. Cox, M. J. Davies, and T. Johnston. June 1960. 31p. BIS.

Kinetic data are presented on the oxidation of Nb-Zr alloys (2 to 80 wt. % Nb) at 300 to 500°C under 1 atmosphere pressure. (For Part X see AERE-M-621.) (C.T.G.)

25882 K-1459

Oak Ridge Gaseous Diffusion Plant, Tenn.
HIGH TEMPERATURE CORROSION OF SOME METALS AND CERAMICS IN FLUORINATING ATMOSPHERES. C. F. Hale, E. J. Barber, H. A. Bernhardt, and Karl E. Rapp. Sept. 30, 1960. 64p. Contract W-7405-eng-26. OTS.

The corrosion of various metals, alloys, and ceramics in fluorine and uranium hexafluoride atmospheres was exam-

lined in the temperature range of 1100 to 1800°F. Of the materials examined only nickel, certain alloys containing nickel as the principal constituent, and the ceramics and cermet composed principally of α -alumina proved resistant to the action of fluorine and uranium hexafluoride through any part of this temperature range. The potential utility of these materials in constructing a homogeneous gaseous-uranium-hexafluoride nuclear reactor was evaluated on the basis of the rates and nature of the corrosive attack by fluorine or uranium hexafluoride. These factors in turn were dependent upon the exposure temperature; the quantity of impurities or alloying elements present in the metals; the chemical and physical natures of these foreign constituents; the properties of their respective fluorides; the thickness of any adherent, impervious, protective metal fluoride film formed prior to or during exposure; and the pressure of the fluorinating gaseous atmosphere. The results of this investigation leave little doubt that diffusion of the fluorinating gas along the grain boundaries of the nickel fluoride film to react at the metal-scale interface is the primary mechanism of attack upon pure nickel and its more promising alloys. At the higher temperatures studied, annealing and crystal growth of the nickel substrate occurred which concentrated the reactive impurities at the grain-boundaries. These changes resulted in an enhanced initial grain-boundary penetration that diminished as the exposure was continued. Because of the serious consequences that result from an attack concentrated at the grain boundaries, a more definitive knowledge of the limits imposed by the prevalence of such an attack is needed before accurate predictions of useful equipment life will be possible. While the penetration rate of the fused α -alumina ceramic is comparable to the average rate of attack upon "A" nickel by fluorine at elevated temperatures, the volatility of aluminum fluoride at temperatures above 1500°F is so high that the specific reaction rate of fluorine with α -alumina would be of greater importance in determining its usefulness than any protection afforded by the aluminum fluoride film. (auth)

25883 NP-9156

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

NOZZLE EROSION IN SOLID PROPELLANT ROCKET MOTORS. George R. Evans, comp. July 15, 1960. 59p. (SB-60-22).

A bibliography of reports on nozzle erosion in rocket motors is presented. The search reflects the holdings of the Lockheed Technical Information Center and ASTIA. Also, indexes such as Aeronautical Engineering Index, 1954 to 57; Aero/Space Engineering (Aeronautical Engineering Review) 1957 to 60; Applied Science and Technology Index (Industrial Arts Index), 1950 to 60; Engineering Index, 1950 to 60; Pacific Aeronautical Library Uniterm Index, 1955 to 60; and Solid Propellant Information Agency Index, 1951 to 60 were searched. 225 references. (J.R.D.)

25884 ORNL-2983(p.54-60)

Oak Ridge National Lab., Tenn.

CHEMISTRY OF CORROSION. R. F. Sympson, F. A. Posey, et al.

A combination of spectrophotometric and electrochemical measurements was made for the analysis of the effect of complexing upon the rate of cathodic reduction of copper(II) species in acidic solutions. The complexing ions were sulfate and thiocyanate, and measurements of the association quotients were made at 25, 34, 49, and 63°C. An electrical analog of a model of the passive interface on a metal was developed with the requirement that it

represent the detailed phenomenology of such systems. The theory is applicable to the study of transients observed in potentiostatic and galvanostatic measurements. The rate of growth of the corrosion film on zirconium was studied electrochemically. A similar study on Zircaloy-2 gave quite comparable results. The rate of reduction of several oxidizing agents on oxidized zirconium electrodes was determined. The comparative rates of reduction of oxygen and several reducible inhibitors on passive iron were determined. With TeO_4^- and CrO_4^{2-} , reduction of oxygen predominates, but with OsO_4 the reverse is the case. The cathodic processes are accelerated by the reduction products $\text{Te}(\text{OH})_4$ and $\text{Os}(\text{OH})_4$. In the study of the action of iodide ions as inhibitor for the dissolution of iron in acidic sulfate media, I^{131} was used to measure the extent of adsorption as a function of ionic activity and anodic current density. Cathodic polarization measurements on iron in solutions containing benzoate ions as inhibitor established the reduction in corrosion rate in such a medium at various concentrations and its independence of the pH value over an appreciable range. (auth)

25885 AEC-tr-4232

STUDIES OF THE EFFECT OF TITANIUM ON THE RESISTANCE OF STAINLESS STEEL CONTAINING 28% Cr AND 9% Ni TO INTER-CRYSTALLINE CORROSION.

Vladimir Cihal and Rudolf Pospisil. Translated from Hutnické listy 11, 284-90(1956). 13p. JCL.

Intercrystalline corrosion of titanium-stabilized stainless steels is discussed. Stability of TiC is examined, and the nature of precipitating carbides is explored. Effects of heat treatment on intercrystalline corrosion are also discussed along with the relations between ferrite and titanium content. (J.R.D.)

25886

OXIDATION MECHANISMS OF NIOBIUM, TANTALUM, MOLYBDENUM, AND TUNGSTEN. O. Kubaschewski and B. E. Hopkins (National Physical Lab., Teddington, Middx., Eng.). J. Less-Common Metals 2, 172-80(1960) Apr.-Aug. (In English)

From published observations on the behavior during oxidation of the metals considered and the properties of the oxides formed, the probable mechanism of oxidation is discussed. The known effects of alloying elements are discussed in the light of this mechanism, and some consideration is given to other possibilities of improving oxidation resistance by simple alloying. (auth)

25887

THE OXIDATION OF NIOBIUM-TITANIUM AND NIOBIUM-MOLYBDENUM ALLOYS. B. B. Argent and B. Phelps (Univ. of Sheffield, Eng.). J. Less-Common Metals 2, 181-90(1960) Apr.-Aug. (In English)

The oxidation rates of several niobium-titanium and niobium-molybdenum alloys were measured at 400 to 1100°C and 400 to 900°C, respectively. The results are given in terms of the chemical and physical properties of the scales. (auth)

25888

THE DEVELOPMENT OF OXIDATION-RESISTANT NIOBIUM ALLOYS. R. Smith (B. S. A. Group Research Centre, Birmingham, Eng.). J. Less-Common Metals 2, 191-206(1960) Apr.-Aug. (In English)

Various mechanisms, by which the addition of an alloying element to niobium may influence the oxidation resistance are examined in the light of previous experimental work. It is concluded that the effects observed are probably due to the combination of a number of factors. A description is given of systematic investigations of the oxidation re-

sistance of an extensive range of ternary and more complex niobium alloys that contain 9 to 25 at. % titanium; these investigations led to success in identifying ductile and refractory alloys showing oxidation rates at 1100°C of about 1% of that of pure niobium metal. (auth)

25809

DEVELOPMENT OF OXIDATION RESISTANCE OF SOME REFRACTORY METALS. G. L. Miller and F. G. Cox (Murex Ltd., Rainham, Essex, Eng.). J. Less-Common Metals 2, 207-22(1960) Apr.-Aug. (In English)

Investigations of the protection of niobium and molybdenum from oxidation by alloying and by applied coatings are described. The niobium alloy containing 17.5 at. % tungsten, 17.5 at. % titanium, and 5 at. % iron shows a great improvement in oxidation resistance over unalloyed niobium, but it is not of the standard required for an oxidation-resistant alloy. An aluminum-chromium-silicon coating affords protection to molybdenum against oxidation at 1200°C for 150 to 200 hr, and the coating shows considerable resistance to thermal shock. Attempts to apply a protective coating to niobium were not successful. (auth)

25890

OXIDATION BEHAVIOUR OF NIOBIUM-CHROMIUM ALLOYS. G. T. J. Mayo, W. H. Shepherd, and A. G. Thomas (Plessey Co., Ltd., Towcester, Eng.). J. Less-Common Metals 2, 223-32(1960) Apr.-Aug. (In English)

An examination of the properties of chromium niobate indicates the possibility of producing an oxidation-resistant niobium-chromium alloy. A series of such alloys was prepared and subjected to oxidation tests. Tests on one of these alloys in different atmospheres reveal a considerably higher oxidation rate in air than in oxygen. A possible mechanism is suggested for this phenomenon. (auth)

25891

THE EFFECT OF OXYGEN PRESSURE ON THE HIGH TEMPERATURE OXIDATION OF TANTALUM. M. G. Cowgill and J. Stringer (Univ. of Liverpool). J. Less-Common Metals 2, 233-40(1960) Apr.-Aug. (In English)

The pressure dependence of the linear rate constant for the oxidation of tantalum was investigated at 600 to 900°C and 1 to 760 mm Hg. The results confirm that the controlling step is preceded by an equilibrium adsorption process, as suggested by Fassell et al., and indicate that at low pressures the rate-controlling step depends on the square root of the oxygen pressure. At lower temperatures and higher pressures another process controls the rate, which varies linearly with pressure. Possible reaction mechanisms are proposed to account for the observations. (auth)

25892

EFFECT OF STRESSES ON THE CHARACTERISTIC SHAPE OF THE POLARIZATION CURVE DURING THE CORROSION CRACKING OF METALS. V. V. Romanov. Zhur. Priklad. Khim. 33, 1849-33(1960) Aug. (In Russian)

Following up previous findings that established that the shape of the polarization curve depends on the anodic or cathodic current density of the protecting current (Doklady Akad. Nauk SSSR 129, 3, (1959)), an attempt was made to establish the effect of stresses on the corrosive process as shown in the polarization curve. Duralumin specimens exposed to a solution containing NaCl + H₂O₂ were used for the tests; the stresses were induced by means of a tensile strength apparatus. It was found that in the anodic zone at stresses ranging from 33 to 35 kg/mm² and an initial current density of 0.05 ma/cm² the curve presents a region that is characteristic for reduction or inhibition of the cor-

rosion reaction. Subsequent increase of the current density resulted in an increase of the rate of the corrosion cracking in an inverse ratio with the stress. At 37 kg/mm² the anodic polarization was not able to slow down the cracking reaction; the anodic portion of the polarization curve had the characteristic shape, but the increase of the corrosion rate was relatively less marked than at 33 to 35 kg/mm². These results contribute to the electrochemical theory of stress corrosion cracking of metals. (TTT)

25893

THE EFFECT OF TEMPERATURE ON THE TYPE OF CORROSIVE DETERIORATION OF STAINLESS STEEL IN ACID SOLUTIONS. A. I. Glukhova. Zhur. Priklad. Khim. 33, 1853-61(1960) Aug. (In Russian)

The type of corrosive attack is of great interest for selecting the most suitable construction material for a given aggressive media. The attack of various acids on a Cr-Ni type stainless steel was investigated at various temperatures ranging from 0 to 110°C. It was established that both a uniform and an intercrystalline type of corrosion act simultaneously; both are dependent on the temperature and the time of exposure. An observable effect was obtained after a 25 hr exposure in 0.1 N HCl solution at 110°C whereas the same solution required a 4500 hr exposure at 20°C. The temperature coefficient of the intergranular type of attack was larger in HCl than the coefficient of the corresponding uniform corrosion; the former was 7×10^{-2} μ /hr °C, and the latter was 6×10^{-3} μ /hr °C. The effect of these factors was also studied in HNO₃ and in mixtures of these two acids. (TTT)

25894

METHOD OF INHIBITING CORROSION IN URANYL SULFATE SOLUTIONS. E. G. Bohlmann and J. C. Griess, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,950,167. Aug. 23, 1960.

A method is given for treating a uranyl sulfate solution to inhibit the corrosiveness of the solution and elevate the phase separation temperature of the solution. Lithium sulfate is added to the solution in an amount ranging from 0.25 to 1.3 times the uranyl sulfate concentration. The corrosiveness of the solution with respect to stainless steel is substantially decreased by this means. This treatment also serves to raise the phase separation temperature of the solution (above 250°C), at which time the uranyl sulfate solution separates into two liquid phases of unequal uranium concentration and thus becomes unsuitable as nuclear reactor fuel.

Fabrication

25895 HW-60358

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

FABRICATION OF THE PRTR ZIRCALOY-2 HIGH PRESSURE PROCESS TUBES. R. L. Knecht. July 31, 1959. 43p. Contract AT(45-1)-1350. OTS.

Problems in the fabrication of Zircaloy-2 high-pressure process tubes for the Plutonium Recycle Test Reactor are discussed. The tapered tubes were designed to operate at 542°F and 1050 psig. (C.J.G.)

25896 KAPL-2087

Knolls Atomic Power Lab., Schenectady, N. Y. WELDING TYPE 410 STAINLESS STEEL TO INCONEL. J. D. Carey. Mar. 25, 1960. 11p. Contract W-31-109-Eng-52. OTS.

Methods of welding Inconel to Type 410 stainless steel with the INCO BP-85 Inconel-covered electrode are de-

scribed. Preheating and postweld heat treatments are incorporated in the welding procedure to prevent cracking of the Type 410 stainless-steel base metal and to retain ductility through the joint. Transverse tensile-test data are listed for the three procedures evaluated. (auth)

25897 KAPL-M-JDC-2

Knolls Atomic Power Lab., Schenectady, N. Y.
A STUDY OF FISSURING IN INCONEL WELDS MADE BY THE METAL INERT GAS SHIELDED ARC WELDING PROCESS. J. D. Carey and G. F. McKittrick. July 22, 1960. 17p. Contract W-31-109-Eng-52. OTS.

A series of single-bead MIG and TIG Inconel welds was made by the inert gas shielded arc welding process with widely varying heat inputs (in joules per inch), interpass temperatures, and weaving techniques to determine the major factor in weld-metal fissuring. It was found that by using a weaving technique with the MIG process, fissuring can be substantially reduced or eliminated. (C.J.G.)

25898 LA-2439

Los Alamos Scientific Lab., N. Mex.
PREPARATION AND FABRICATION OF PLUTONIUM FUEL ALLOY FOR LOS ALAMOS MOLTEN PLUTONIUM REACTOR EXPERIMENT NO. 1. J. W. Anderson, W. D. McNeese, and J. A. Leary. Apr. 15, 1960. 28p. Contract W-7405-eng-36. OTS.

Tantalum-sheathed plutonium fuel pins were prepared for the first core loading of the Los Alamos Molten Plutonium Reactor Experiment-I. Plutonium-10 at. % iron alloy was prepared by co-reduction and by co-melting methods. After casting the alloy into rods, each rod was machined and finished to a 0.357-in.-diameter piece weighing 175 g. The finished alloy rod was finally placed in a tantalum sheath, then sealed by fusion welding to a tantalum cap. Procedures and equipment used for alloying, casting, machining, welding, and inspection are described. Methods used to prepare rods of other low-melting plutonium alloys also are discussed. (auth)

25899 NP-9108

Westinghouse Electric Corp. Lamp Div., Bloomfield, N. J.

RESEARCH AND DEVELOPMENT WORK ON THE EXTRUDABILITY AND EXTRUDED PROPERTIES OF SINTERED AND ARC-CAST MOLYBDENUM ALLOYS. Final Report for No. 11 April 3, 1958 to March 31, 1960. Mar. 31, 1960. 40p. Contract DA-30-069-505-ORD-2246.

Twelve billets of the sintered molybdenum-0.1% cobalt alloy, each measuring approximately $4\frac{1}{4}$ in. in diameter and $8\frac{1}{2}$ in. in length were prepared by powder metallurgical techniques. Twelve billets of the arc-cast molybdenum-0.5% titanium alloy, each conforming to the dimensions given above, were procured from the Climax Molybdenum Company of Michigan. All billets were visually inspected by Dy-Chekking for surface imperfections to ensure using only sound material for the extrusion operation. Densities, hardness, alloy content, and microstructures were taken on representative samples from both the powder metallurgy and arc-cast billets. The billets were extruded at the Babcock & Wilcox Co. plant located at Beaver Falls, Pa. Billets were extruded at temperatures ranging from 2000 to 3000°F at reduction ratios ranging from approximately 2:1 to 5:1 for the arc-cast product and 2:1 to 3.9:1 for the powder-metallurgy product. Difficulties were encountered when using a steel back-up block between the ram and the billet, which necessitated changing to the use of carbon back-up blocks midway in the extrusion experiment. Consequently the data which were ob-

tained cover variables other than temperature, reduction ratios, and material. (auth)

25900 ORNL-2993(p.97-102)

Oak Ridge National Lab., Tenn.

FUEL CYCLE DEVELOPMENT.

Experimental studies of simplified methods for recycle of Th- U^{233} fuel to heterogeneous reactors have indicated that high-density oxides can be loaded to acceptably dense oxide fuel cores by vibratory compaction into cladding tubes. Compaction of arc-fused thorium oxide and mixed thorium-uranium oxides by pneumatic vibrators consistently gave bulk densities in stainless-steel tubes which were 87% of theoretical. Compaction was best with a pneumatic vibrator which imparted a sharp impact to the tube on its upstroke but not on the downstroke. The application to fuel-element fabrication promises to provide an economically feasible method of recycling U^{233} and thorium to heterogeneous reactors under shielded conditions. (auth)

25901 SCNC-289

Sylvania Corning Nuclear Corp., Bayside, N. Y.

LOW COST CERAMIC FUEL ELEMENTS BY ISOSTATIC PRESSING. J. Fugardi and J. L. Zambrow. July 1959. Decl. Nov. 18, 1959. 22p. Contract AT-30-[1]-GEN-366. OTS.

Sample fuel elements consisting of a ceramic core in stainless-steel cladding were prepared by tamping powder into the cladding and then hot isostatically pressing the assembly. High-density cores and an excellent mechanical bond between the core and the cladding were obtained. (auth)

25902 TID-6591

Carborundum Co. Research and Development [Div.], Niagara Falls, N. Y.

SYNTHESIS AND FABRICATION OF REFRACTORY URANIUM COMPOUNDS. Quarterly Report No. 4 [for] March 1 to April 30 and July 1 to July 31, 1960. K. M. Taylor, C. A. Lenle, P. E. Doherty, and C. H. McMurtry. Aug. 10, 1960. 15p. OTS.

Additional work on the synthesis and fabrication of uranium nitride produced an improved product free of oxide contamination as indicated by x-ray analysis. Further work to increase the density of the sintered pellets is needed. A stock of several pounds of stoichiometric uranium monocarbide was prepared by carbon reduction of uranium dioxide. Pellets having bulk densities ranging from 93 to 96% theoretical were obtained by cold pressing and sintering. Initial experiments on the fabrication of bars, 3 by $\frac{1}{2}$ by $\frac{1}{4}$ in., by cold pressing and sintering, resulted in sound but somewhat low-density bodies. A few experiments were conducted on the production of uranium monocarbide from ammonium diuranate. The results indicate that considerable additional work may be necessary to consistently produce a stoichiometric product. The simultaneous synthesis and hot pressing of uranium monocarbide was further studied and pellets with bulk densities as high as 96.6% theoretical (based on 100% UC) were produced. However, metallographic examination disclosed the presence of some free uranium metal in all pellets. The synthesis of 1-lb batches of U_3Si_2 of improved quality was successfully carried out by a nonquench method. Using the U_3Si_2 so produced, sound pellets with bulk densities up to 98.5% theoretical were prepared by cold pressing and sintering. The sintering technique was also used to produce 3- by $\frac{1}{2}$ - by $\frac{1}{4}$ -in. bars for physical-property tests. (auth)

25903

PRACTICAL ASPECTS OF SINTERING TUNGSTEN AND MOLYBDENUM. D. J. Jones (General Electric Co., Ltd.,

Wembley, Eng.). *J. Less-Common Metals* **2**, 76-85(1960) Apr.-Aug. (In English)

Manufacturing procedures for the preparation of tungsten and molybdenum powders together with the method of pressing the powders in a mold and direct sintering the pressed bars at high temperatures are given. A description is given of the method of sintering, in particular, molybdenum in a hydrogen-water vapor atmosphere at about 1750°C and the continuous pressing, partial sintering, and casting technique developed to meet demands for relatively large size plate and sheet. Reference is made to the preparation of alloys by sintering in the presence of a liquid phase and pseudo alloys by the infiltration technique. (auth)

25904

THE EFFECT OF ROLLING TEMPERATURE ON THE MECHANICAL PROPERTIES OF MOLYBDENUM. J. A. Belk, E. W. Ward, A. J. Nicol Smith, and J. M. Clyne (Armament Research and Development Establishment, Fort Halstead, Eng.). *J. Less-Common Metals* **2**, 86-94 (1960) Apr.-Aug. (In English)

The effect of initial breakdown at 1350 or 1000°C and final rolling at 1000, 800, 600, or 400°C on the mechanical properties of arc-melted molybdenum is shown. Tensile, impact, and slow bend test results are presented, and the influence of stress relief and recrystallization is illustrated. The bearing of these results on the production and properties of strip and sheet is discussed. (auth)

25905

ELECTRON BEAM FUSION AND ITS APPLICATIONS. N. F. Eaton (Associated Electrical Industries, Ltd., Manchester, Eng.). *J. Less-Common Metals* **2**, 104-12 (1960) Apr.-Aug. (In English)

A description is given of the principles involved in the production and utilization of electron beams for fusion applications. The advantages of the process over induction or arc fusion methods for welding, ingot production, and zone refining are discussed from a metallurgical and operational point of view. Details are given of equipment under development for ingot production and zone refining. (auth)

25906

THE ANNEALING OF WORKED TUNGSTEN. F. O. Jones (Associated Electrical Industries, Aldermaston, Berks, Eng.). *J. Less-Common Metals* **2**, 163-71(1960) Apr.-Aug. (In English)

Structural changes occurring during the annealing of worked tungsten were followed using the transmission electron microscopy technique. It is suggested that the technique could be used as a means of studying the effect of additions on the recrystallization process. The observations are related to the brittleness of tungsten. (auth)

25907

A 45-kw ELECTRON BEAM-MULTICHAMBER FURNACE FOR MELTING AND CASTING VARIOUS METALS. M[anfred] von Ardenne (Forschungsinstitut Manfred von Ardenne, Dresden-Weisser Hirsch, Ger.). *Kernenergie* **3**, 507-17(1960) June. (In German)

The operation and performance of a 45-kw electron-beam multichamber furnace are described. By using the multichamber principle in combination with established vacuum techniques and electron-optical methods, electron beam melting is achieved for the first time in which, even with strong outgassing of the charge, both the beam energy and contour remain completely constant. Measurements show that the pressure in the furnace vessel should reach values of 3×10^{-2} Torr without the pressure in the beam

chamber exceeding the pressure of 10^{-4} Torr, which is critical for stable operation. These improvements open up the electron-beam melting process, which was formerly limited to a few high-melting metals, to the wide range of strong gas-adsorbing metals and other gas-adsorbing materials and mixtures. The furnace construction is so arranged that it can also be used when provided with simple attachments for alloying, casting, sintering, vaporization, or welding of metals in high vacuum. The process embodied in this apparatus has the further advantages of highest purity, convenient current and current-density regulation, simple construction, and the efficient use of electricity of the furnace and its feed mechanism. A related finding that would be of interest in the field of electron physics was reported. An electron filament beam was produced which had a current of almost 1 amp and a 2.5-mm diameter. (tr-auth)

25908

HELIUM LEAK TESTING FUEL RODS FOR THE PWR BLANKET. E. A. Oaks (Westinghouse Electric Corp., Pittsburgh). *Nondestructive Testing* **18**, 319-22(1960) Sept.-Oct.

The integrity of PWR-I blanket element cladding was tested using a helium leak detector. Its use enabled the detection and rejection of leaking elements prior to insertion into the reactor. This resulted in a considerable reduction in the problems associated with the operation and maintenance of the Pressurized Water Reactor. The low failure rate during service shows that the test methods were satisfactory. (B.O.G.)

25909

SPRAY TECHNIQUE APPLIES SHIELDING CONCRETE. Frank C. Hume (B. D. Bohna and Co., Ltd., Vancouver, B. C.). *Nucleonics* **18**, No. 10, 102; 104(1960) Oct.

An economical method is described for applying dense magnetite concrete shields. The method sprays rather than pours the concrete. The method is advantageous from the standpoint of both cost and quality over conventional techniques. Pneumatically applied concrete is known by the trade name "Gunite." Compressed air traveling through a hose carries a dry cement and fine aggregate mixture to the face that is to be shielded. At the nozzle, water is added under pressure to complete the mix. The advantages of the Gunite process are lower final costs; faster construction; greater density and strength; fewer voids; no damage to inserts; no heat problem; and a trowel finish. (B.O.G.)

25910

STUDIES OF METHODS FOR SEALING ENDS OF REACTOR FUEL RODS FOR PWR. J. J. Vagi and D. C. Martin (Battelle Memorial Inst., Columbus, Ohio). *Welding J.* (N.Y.) **39**, 443s-8s(1960) Oct.

As part of the Westinghouse Atomic Power Division program for developing fuel rods for Pressurized Water Reactor, methods for sealing the ends of Zircaloy-2-clad uranium-12 wt. % molybdenum-cored fuel rods made by coextrusion were investigated. Attempts were made to join Zircaloy-2 end plugs to the rod by means of pressure bonding, resistance welding, and fusion welding. Exploratory tests indicated that resistance upset welding was promising. Tension-test fractures occurred in the Zircaloy-2 end caps away from the weld joint when materials were vacuum-treated prior to upset welding. Percussion welding and flash welding were eliminated from extensive consideration because molten-core alloy was extruded out along the cladding-to-end-cap bond line when these processes were used. Attempts to fusion weld an

overlay on the ends of the fuel rods resulted in end seals that had uranium at the surface and also contained gas porosity. (auth)

25911

VOLATILIZATION PHENOMENA IN HIGH-TEMPERATURE BRAZING FILLER ALLOYS. William Lehrer and Harry Schwartzbart (Raytheon Mfg. Co., Newton, Mass.). *Welding J. (N.Y.)* 39, 449s-61s(1960) Oct.

Experimental brazing filler alloys were developed containing temperature depressants that were volatilized during the brazing of stainless steel leaving joints of high-remelt temperature. The mechanisms by which remelt temperature is increased were studied for the range of alloys investigated which contained nickel, chromium, germanium, iron, lithium, and phosphorus. The main mechanisms are dissolution of the base metal in the filler metal and diffusion of constituents of the filler metal into the base metal and volatilization of the filler metal constituents. It was shown theoretically and experimentally that, in order for remelt temperature to increase, there must be solid solubility of the diffusing or volatile element in the filler alloy. Although compositional changes may result from either mechanism, a remelt temperature change does not necessarily occur. The degree to which a compositional change affects remelt temperature is proportional to the solid solubility. In this program, vacuum pumping was the most efficient vapor-removal method among several discussed and investigated. Furthermore, under vacuum the surface-area-to-volume ratio of the filler alloy became less rate-controlling owing to boiling. Boiling, however, caused porosity in the joint. Of the alloys investigated, a 61% niobium-39% indium alloy exhibited the greatest remelt temperature rise owing to volatilization alone, whereas a 94% niobium-6% phosphorus responded only to dissolution and diffusion to exhibit the largest rise in remelt temperature owing to this mechanism. Nickel-chromium-indium-germanium alloys exhibited a substantial rise in remelt temperature owing to the operation of both mechanisms. This alloy and the binary nickel-indium alloy can be considered practical alloys for high-temperature usage. A direct effect of metallic vapors on wetting and flow of the filler alloy was observed and subsequently discussed with respect to their influence on surface-tension relationships. It was shown that in the presence of metal vapors, discoloration of the base metal, wetting, flow, and skull formation of the filler alloy are functions of the rate and quantity of metal-vapor removal. (auth)

25912

DETERMINATION OF THE THICKNESS OF ZINC COATINGS BY MEANS OF "TAGGED" ATOMS. I. A. Berman and S. A. Khaletskaya. *Zavodskaya Lab.* 26, 836-7 (1960). (In Russian)

A zinc layer is usually deposited first on aluminum goods from sodium zincate solution in order to ensure good adherence of the subsequent chromium plating. The effect of the various experimental parameters on the thickness of the deposited zinc layer was investigated by using the 255-day half-life Zn^{65} isotope, introducing 2.5 mc into the strongly alkaline solution. The method was found to be sensitive enough to allow determination of the thickness of an average zinc layer within a few tens of minutes. By using this method, it was found that under certain conditions the zinc layer is dissolved in the electrolytic bath used for chromium plating and the oxide layer formed on the aluminum surface is the cause of the poor adherence of chromium that is observed on occasions. (TTT)

25913

IMPROVEMENTS RELATING TO NEUTRON-ABSORBING BODIES FOR USE IN NUCLEAR REACTORS. David Kenneth Worn and Ernest James Bradbury (to Mond Nickel Co., Ltd.). British Patent 838,442. June 22, 1960.

Ductile reactor control rods can be made from a discrete phase of neutron-absorbing material dispersed in a matrix if the phase is made coarse enough to be retained on a 200-mesh B.S.S. screen, but fine enough to pass through a 60-mesh B.S.S. screen. Suitable phase-matrix combinations that are stable up to 900°C are boron carbide and copper, gadolinium oxide and nickel or iron, and europium oxide and nickel or iron. The shaped sintered bodies may be covered by stainless steel or other corrosion-resistant alloys. (D.L.C.)

25914

IMPROVEMENTS IN AND RELATING TO THE COATING OF METALLIC SURFACES. (to Pyrene Co., Ltd.). British Patent 843,054. Aug. 4, 1960.

A method for covering titanium, zirconium, beryllium, and their alloys with a complex fluoride coating is given for the purpose of improving the cold-working properties of the metals and consists of dipping the metal surface in a solution containing more than 2 wt. % of a complex acid of fluorine. In this way, coatings of 1 to 10 g/m² may be obtained. The solution may also contain HF or simple fluorides, and it may contain a surface-active agent, preferably a nonionic polyoxyethylene derivative, to make the coating action more uniform. Four applications of this method are given for titanium, using fluosilicic, fluoboric, fluophosphoric, and fluosulfonic acids, the last being least effective in giving the surface an adsorptive coating. (D.L.C.)

25915

NUCLEAR REACTORS. Leslie Mark Wyatt (to United Kingdom Atomic Energy Authority). British Patent 843,091. Aug. 4, 1960.

Fuel elements having multiple heat conducting paths scattered throughout the fuel mass can be fabricated using fissile wires coated with a metal of high thermal conductivity. A plurality of such wires are swaged or pressed together to exclude all voids between wires and to form an assembly, and the assembly given an over-all metal plating or tubular sheath. Such assembled elements are suitable for use in reactors of the type described in Patent Serial No. 826,931. Typically, the wires are silver-coated plutonium, 19 of which are swaged to form an element 6 in. long and 0.31 in. in diameter with a 0.015-in. stainless-steel sheath. (D.L.C.)

25916

FUEL ELEMENT COMPOSITION AND PROCESS OF MAKING SAME. (to U. S. Atomic Energy Commission). British Patent 847,013. Sept. 7, 1960.

A solid solution of PuO_2 in UO_2 is proposed for use as fuel for heterogeneous reactors, whether fast, intermediate, or slow. The advantages of such a fuel are its uniform composition, ease of fabrication, and ease of reprocessing after use. The mixture is prepared from $UO_2(NO_3)_2$ and $Pu(NO_3)_4$ solutions mixed in the desired uranium/plutonium ratio (giving 2 to 99 parts UO_2 to 1 part PuO_2) and precipitating the oxides by NH_3 . The solid is calcined at 600 to 1000°C in H_2 for 1 to 2 hr to give a material ready for pelletization or charging into a stainless-steel tube as an element. After ~50% burn-up of the original plutonium, the mixture is readily dissolved in hot HNO_3 and subjected to solvent extraction methods of recovery. An example of preparation of the

fuel is given together with the procedure for its pelletization. (D.L.C.)

25917

IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF SINTERED BODIES. Alan Blainey (to United Kingdom Atomic Energy Authority). British Patent 847,231. Sept. 7, 1960.

A method of producing shaped bodies of metals and electrically conducting metal compounds is outlined whereby the mass in a mold is heated by electric current and compressed, a substance being present which is vaporized during the heating and compacting processes. An example of the method is given in which a dense uranium rod is produced from uranium flakes ball-milled in oil and compacted in a silica tube closed with copper plungers. The oil is vaporized and furnishes an inert atmosphere, preventing oxidation of uranium. The method can be applied to other materials, e.g., beryllium flakes, tungsten powder, and hard metal carbide powders such as tungsten carbide. The heating process may be carried only to a point where sufficient local superficial softening of the particles occurs to fuse them together. (D.L.C.)

25918

IMPROVEMENTS IN OR RELATING TO THE FORMING OF BERYLLIUM. Nigel Austin Hill (to United Kingdom Atomic Energy Authority). British Patent 848,269. Sept. 14, 1960.

Beryllium, a brittle material easily oxidized in air above 750°C, can be formed in air below 750°C by supporting with a ductile metal to which beryllium will adhere without welding. The ductile metal should be mild steel of twice the thickness of the beryllium to be formed, and the forming operation should be carried out at 630 to 670°C. Steel or aluminum alloys can also be employed as the ductile metal. Three examples are given of cupping a beryllium disk, pressing a beryllium sheet into a square dish, and bending a beryllium strip at right angles. Beryllium sheet up to 0.080-in. thick can be formed in this way. (D.L.C.)

25919

METHOD OF IMPREGNATING A POROUS MATERIAL. G. N. Steele (to U. S. Atomic Energy Commission). U. S. Patent 2,939,803. June 7, 1960.

A method of impregnating a porous body with an inorganic uranium-containing salt is outlined and comprises dissolving a water-soluble uranium-containing salt in water; saturating the intercommunicating pores of the porous body with the salt solution; infusing ammonia gas into the intercommunicating pores of the body, the ammonia gas in water chemically reacting with the water-soluble uranium-containing salt in the water solvent to form a non-water-soluble uranium-containing precipitant; and evaporating the volatile unprecipitated products from the intercommunicating pores whereby the uranium-containing precipitate is uniformly distributed in the intercommunicating pores of the porous body.

25920

PROCESS FOR JACKETING A CORE. G. A. Last (to U. S. Atomic Energy Commission). U. S. Patent 2,945,293. July 19, 1960.

A process is given for enclosing the uranium core of a nuclear fuel element by placing the core in an aluminum cup and closing the open end of the cup over the core. As the metal of the cup is brought together in a weld over the center of the end of the core, it is extruded inwardly as internal projection into a central recess in the core and outwardly as an external projection. Thus oxide inclusions in the weld of the cup are spread out into the internal and ex-

ternal projections and do not interfere with the integrity of the weld.

25921

PROCESS OF IMPREGNATING GRAPHITE WITH A URANIUM COMPOUND. M. C. Sanz, R. R. Randolph, and C. Starr (to U. S. Atomic Energy Commission). U. S. Patent 2,946,699. July 26, 1960.

A process of forming reactor material is given comprising impregnating graphite with uranyl nitrate and heating the graphite until the salt is converted into an oxide.

25922

METHOD FOR MAKING FUEL ELEMENTS. L. W. Kates, R. W. Campbell, and R. H. W. Heartel (to U. S. Atomic Energy Commission). U. S. Patent 2,947,080. Aug. 2, 1960.

A method is given for making zirconium-clad uranium wire. A tube of zirconium is closed with a zirconium plug, after which a chilled uranium core is inserted in the tube to rest against the plug. Additional plugs and cores are inserted alternately as desired. The assembly is then sheathed with iron, hot worked to the desired size, and the iron sheath removed.

25923

METHOD OF MAKING WIRE FUEL ELEMENTS. J. L. Zambrow (to U. S. Atomic Energy Commission). U. S. Patent 2,947,676. Aug. 2, 1960.

A method is given for making a nuclear reactor fuel element in the form of a uranium-bearing wire clad with zirconium. A uranium bar is enclosed in a zirconium sheath which is coated with an oxide of magnesium, beryllium, or zirconium. The sheathed bar is then placed in a steel tube and reduced to the desired diameter by swaging at 800 to 900°C, after which the steel and oxide are removed.

25924

METHOD OF PRODUCING U^{233} . G. T. Seaborg and R. W. Stoughton (to U. S. Atomic Energy Commission). U. S. Patent 2,951,023. Aug. 30, 1960.

A method for producing U^{233} is outlined in which a body of thorium carbonate is heated to at least 200°C until it attains a constant weight and compressing the body into a pellet having a density of at least 2.6 g/cm³. The pellet is enclosed in a sealed container and placed in the blanket of a thermal nuclear reactor having a neutron flux in which the majority of neutrons have an energy of below 1 Mev. The pellet is removed from the flux before the ratio of U^{233} to Th^{232} is about 1:100.

Properties and Structure

25925 60-GC-124

General Electric Co. Research Lab., Schenectady, N. Y. LOW-TEMPERATURE BRITTLINESS OF REFRACTORY METALS. Annual Summary Report No. II [for] July 31, 1959 to July 31, 1960. H. W. Schadler and J. R. Low, Jr. Aug. 1960. 27p. Contract Nonr-2614(00).

The recrystallization characteristics of cold-rolled tungsten single crystals produced by electron-bombardment floating-zone refining were studied. Tungsten single crystals of various orientations were rolled 44, 70, 76, and 85% reduction in area at 450 and 400°C and annealed at 600 to 1600°C. Hardness of each specimen and the effect of annealing temperature on the grain size of the recrystallized material were determined. Procedures for producing polycrystalline tungsten are contained. Studies on the fracture characteristics of polycrystalline tungsten revealed that

grain boundaries are important to the initiation of fracture, even in high-purity tungsten, that twinning is a factor in the propagation of brittle cracks, and that twins may initiate brittle fracture. Attempts to measure the stress and temperature dependence of dislocation velocities in high-purity tungsten single crystals were not successful because all of the dislocations present in the crystal moved under the applied stress. The strain-rate sensitivity of tungsten single crystals was measured at 298 and 77°K for strains of 1 to 10%. The strain-rate sensitivity at 77°K is 60% of that at 298°K. (C.J.G.)

25926 AERE-M-694

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

SOLID SOLUTIONS OF URANIUM DIOXIDE IN ZIRCONIA WITH THE MONOCLINIC ZrO_2 (BADDELEYITE) STRUCTURE. I. F. Ferguson. May 1960. 5p. BIS.

X-ray powder-diffraction studies were made on solid solutions of UO_2 in ZrO_2 which have the monoclinic ZrO_2 (baddeleyite) structure. The unit cell dimensions of 'Specpure' ZrO_2 and $Zr_{0.95}U_{0.05}O_2$ respectively, were determined as: $a = 5.142 \pm 0.005A$, $b = 5.203 \pm 0.005A$, $c = 5.325 \pm 0.005A$, $\beta = 99.1 \pm 0.1^\circ$; and $a = 5.180 \pm 0.005A$, $b = 5.215 \pm 0.005A$, $c = 5.344 \pm 0.005A$, $\beta = 99.2 \pm 0.1^\circ$. The solid solution $Zr_{0.90}U_{0.10}O_2$ transformed to a tetragonal structure between 800 and 1000°F. (auth)

25927 ARF-2176-6

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

DISPERSED PHASE STRENGTHENING OF CORROSION-RESISTANT ALUMINUM. Final Report [for] April 1, 1959 to April 1, 1960. May 6, 1960. 49p. For Argonne National Lab. Contract W-31-109-eng-38, Subcontract 31-109-38-1068. (ANL-6188). OTS.

A program in which corrosion-resistant aluminum alloys were dispersion-strengthened by powder metallurgical methods is described. The alloy was obtained in powder form, mixed with hard, stable dispersant powders of Al_2O_3 , $AlPO_4$, SiO_2 , B_4C , and SiC by various methods, compacted, and extruded. Tensile strengths of extruded rods were, in some cases, triple that of the extruded, dispersion-free powder product. Corrosion resistance of these materials was observed to be equivalent to that of the wrought dispersion-free alloy. (auth)

25928 ARF-2191-1

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

IMPROVED VANADIUM-BASE ALLOYS. Bimonthly Report No. 1 [for] December 1, 1959-January 31, 1960. B. R. Rajala and R. J. Van Thyne. Feb. 23, 1960. 12p. Contract NOas-60-6056-c. (AD-234613).

Research for the previous year is reviewed and work projected for the current year is outlined; this investigation is to develop sheet alloys with improved elevated-temperature strength. Promising V-Ti-Nb-X, V-Zr-Nb-X, and V-Nb-X alloys were prepared, fabricated into sheet, and tensile tested at room temperature and at 2000 and 2200°F. Specimens were protected by an inert atmosphere at the elevated temperature because of lack of oxidation resistance. The V-5 wt. % Ti-20 wt. % Nb alloy exhibits a tensile strength of 33,400 psi at 2200°F, a value comparable on a density-corrected basis to the best sheet alloys for this temperature. (auth)

25929 BMI-1467

Battelle Memorial Inst., Columbus, Ohio.

STABILIZING EFFECTS OF OXIDE ADDITIONS TO URA-

NIUM OXIDE. Wendell B. Wilson and Arnold F. Gerds. Sept. 13, 1960. 15p. Contract W-7405-eng-92. OTS.

An investigation of the stabilizing influence of oxide additions to uranium oxide was continued. These additions are employed to eliminate the phase transformation to U_3O_8 which occurs when UO_2 is exposed to an oxidizing environment at elevated temperatures and to reduce the volatility or transpiration losses of uranium oxide which become appreciable in air at temperatures in excess of 1200°C. The results show that CaO may be successfully employed in partial substitution for La_2O_3 and Y_2O_3 . The resulting solid solutions exhibited high-temperature stability comparable to that of the "binary" solid solutions of UO_2 containing La_2O_3 or Y_2O_3 . On the basis of these and other results some alternative approaches appear possible to reduce the amount and cross section of additive required for stabilization. (auth)

25930 CW-R&DL-1

Canadian Westinghouse Co., Ltd., Hamilton, Ont.

ANNUAL PROGRESS REPORT ON THE BERYLLIUM RESEARCH PROJECT, 1959. W. D. Bennett. Apr. 1960. 65p. For Atomic Energy of Canada Ltd. (AECL-1029). (AECL).

The work described consisted primarily of evaluating different grades of beryllium by metallographic and x-ray methods and carrying out a series of stress-rupture and tensile tests at high temperatures on the grades which showed some promise. Following these tests, metallographic studies were made on the fracture regions in a search for indications of grain-boundary void formation. Extruded $\frac{1}{2}$ -in.-diameter beryllium rod was received from two separate sources: Pechiney and Nuclear Metals. (W.L.H.)

25931 DMIC-134

Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.

STRAIN AGING OF REFRACTORY METALS. A. G. Imgram. Aug. 12, 1960. 66p. Contract AF18(600)-1375. (PB-151092). OTS.

The available data on strain-aging behavior of twelve refractory metals (vanadium, niobium, tantalum, chromium, molybdenum, tungsten, ruthenium, rhodium, palladium, osmium, iridium, and platinum) were reviewed and interpreted in terms of the dislocation models proposed by Cottrell. Cottrell pictures the strain-aging phenomenon as a result of the diffusion of interstitial solute atoms to positions of lowest energy in the stress fields of dislocations in body-centered-cubic metals. A segregation of interstitial solute atoms at dislocation lines (Cottrell Atmosphere) restricts their movement and is the cause of yield-point discontinuities. The return of a yield point in strained specimens is associated with the diffusion of interstitial solute atoms back to the dislocation lines after the specimen has yielded and the dislocations have been pulled free of their locking atmospheres. Maximum points in strength vs. temperature curves and serrated stress-strain curves are attributed to the continuous diffusion of interstitial solute atoms to the vicinity of moving dislocation as a specimen is being strained. It is thought that substitutional solute atoms are responsible for the strain-aging behavior of face-centered-cubic and hexagonal-close-packed metals. The body-centered-cubic metals in Group V-A (tantalum, niobium, and vanadium) tend to exhibit greater strain-aging effects and a lower transition temperature than do those in Group VI-A (tungsten, molybdenum, and chromium). Available data indicate that strain aging is a result of the interaction of dislocations with oxygen and carbon in tantalum, oxygen and possibly hydro-

gen in niobium, carbon in molybdenum, and nitrogen in chromium. The interstitial solute atoms responsible for the strain aging of vanadium and tungsten are unknown. The face-centered-cubic (rhodium, palladium, iridium, and platinum) and hexagonal-close-packed (ruthenium and osmium) metals in Group VIII-A exhibit strain-aging effects similar to those observed in the two groups of body-centered-cubic refractory metals. However, the available data do not permit the determination of the identity of the substitutional solute atoms causing the strain-aging effects. (auth)

25932 DMIC-135

Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.

DESIGN INFORMATION ON PH 15-7 Mo STAINLESS STEEL FOR AIRCRAFT AND MISSILES. R. J. Favor, O. L. Deel, and W. P. Achbach. Aug. 22, 1960. 43p. Contract AF18(600)-1375. (PB-151093). OTS.

A summary of design information pertinent to the use of PH 15-7 Mo stainless steel in aircraft and missile applications is presented. Welding problems are discussed briefly. Data on the elevated-temperature mechanical properties of this alloy were collected and evaluated. The presentation and evaluation of these data are in accordance with procedures employed by the ANC-5 Committee. (auth)

25933 DMIC-Memo-64

Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.

RECENT DEVELOPMENTS IN SUPERALLOYS. H. J. Wagner. Sept. 8, 1960. 17p. OTS.

Data on the improvements in mechanical and physical properties of cobalt- and nickel-base superalloys are reviewed. (C.J.G.)

25934 GAMD-1234

General Atomic Div., General Dynamics Corp., San Diego, Calif.

MEASUREMENT OF THE DISPERSION OF CONDUCTIVITY APPLICATION TO TWO URANIUM OXIDE-ALUMINUM OXIDE SAMPLES. Donald P. Snowden. [195?]. 12p. Project No. 40.04. Contract AT(04-3)-187. (MGCR-M-271). OTS.

The dispersion of a-c conductivity of $UO_2-Al_2O_3$ samples was measured as a function of the frequency range 5×10^4 to 3×10^5 cycles. (C.J.G.)

25935 HR-60-479

Honeywell Research Center, Hopkins, Minn.

EFFECT OF SLIP DISTRIBUTION ON THE FRACTURE BEHAVIOR OF MAGNESIUM OXIDE SINGLE CRYSTALS. Technical Report No. 8. R. J. Stokes, T. L. Johnston, and C. H. Li. June 1960. 40p. Contract Nonr-2456(00).

The tensile deformation of chemically polished MgO crystals was correlated with the distribution of slip at the onset of plastic flow. If two slip bands, generated on orthogonal $\{110\}$ planes, happen to intersect to nucleate a crack before other slip bands develop nearby, then the crack so formed was found to be unstable and the crystal completely brittle. It is shown that if a higher density of slip sources exists, cracks become stabilized by adjacent slip bands and the crystals continue to deform. If slip is confined to a single slip band which expands laterally to fill the entire gage length, these crystals were determined to be extremely ductile. The fracture behavior of a given crystal depended critically upon the relative orientation, number, thickness, and spacing between slip bands. It was found that the density of slip can be increased artificially when dislocation sources are injected into the crystal surface by sprinkling with carborundum before loading. Such

crystals were always ductile in tension. A similar treatment for crystals to be bent led to a profound change in their fracture behavior. (auth)

25936 HW-63106

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

CLASSIFICATION OF PuO_2 PARTICLES. J. B. Burnham. Jan. 6, 1960. 15p. OTS.

An apparatus was designed for use in classification of submicron-size PuO_2 particles by a sedimentation technique. Satisfactory yields were obtained with greater than 80% separation efficiency for the desired size fraction. The size distribution and morphology of the PuO_2 particles were also determined. (J.R.D.)

25937 KAPL-2084

Knolls Atomic Power Lab., Schenectady, N. Y.

CYCLIC STRAIN FATIGUE OF INCONEL AT 75 TO 600°F. A. E. Dinerman. Aug. 15, 1960. 18p. Contract W-31-109-Eng-52. OTS.

Cyclic-strain-fatigue tests performed at 75, 200, 400, and 600°F showed that the strain-fatigue strength of Inconel increases slightly with temperature up to 400°F; thereafter, the strain-fatigue strength decreases with increasing temperature. In the temperature range covered by the tests, a plot of total strain vs. cycles to failure shows that the strain-fatigue strength of Inconel is in the same order of magnitude as that of AISI Type 347 stainless steel. (auth)

25938 NASA-TN-D-447

National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

INVESTIGATION OF PROBLEMS ASSOCIATED WITH THE USE OF ALLOYED MOLYBDENUM SHEET IN STRUCTURES AT ELEVATED TEMPERATURES. Eldon E. Mathauser, Bland A. Stein, and Donald R. Rummler. Oct. 1960. 60p. OTS.

The results of an experimental study to explore the capabilities and limitations of thin molybdenum-alloy (Molybdenum-0.5% titanium) sheet for structural applications at high temperatures are presented. Evaluation tests at temperatures ranging from room temperature to 3000°F were made on resistance-welded corrugated-core sandwiches with a W-2 coating, and on coated oxidation and tensile specimens. The performance of the corrugated-core sandwiches in compressive strength and static-oxidation tests, tensile properties of coated molybdenum sheet, and life of the coated specimens in static-oxidation tests are given. The equipment and procedures utilized in the evaluation tests are described. (auth)

25939 NDA-Memo-2136-2

Nuclear Development Corp. of America, White Plains, N. Y. THERMAL CYCLING TESTS ON U-10 w/o Mo FOR THE ORNL FAST BURST REACTOR. B. Minushkin. July 30, 1960. 25p. For Oak Ridge National Lab. Contract 93X-81334-C. OTS.

One of the uncertainties concerning the use of uranium-10 wt. % molybdenum in the ORNL Fast Burst Reactor is the thermal-cycling behavior of this alloy. Accordingly, an experimental program was undertaken to determine whether transformation or distortion of gamma-phase uranium-10 wt. % molybdenum can occur during simulated fast-burst-reactor thermal cycling, and, should transformation occur, to establish the thermal cycling behavior of partially transformed uranium-10 wt. % molybdenum. Specimens were prepared by vacuum casting pins in coated-graphite molds, homogenizing the castings at 1650°F for 24 hr, and centerless grinding and cutting to 0.158-in. diameter by 1.5 in. long. The pins were sealed in evacuated Vycor tubes, heated

rapidly both above and below the gamma-transformation temperature, and then cooled slowly to simulate reactor thermal cycling. Measurements of the time required to initiate transformation by conventional isothermal methods were employed to insure that the alloy material behaved as indicated in the literature. Observation of changes in appearance, dimensions, density, resistivity, and metallographic structure were used to obtain the desired information. It was found that thermal cycling did not cause growth or distortion of either gamma-phase or partially transformed uranium-10 wt. % molybdenum pins. Transformation of gamma phase to $\alpha + \delta$ was not initiated by thermal cycling below the equilibrium gamma-transition temperature. (auth)

25940 NP-8984

Battelle Memorial Inst., Columbus, Ohio.

INVESTIGATION OF SINTERABLE POWDERS AND BERYLLIUM OXIDE PROPERTIES. Quarterly Report No. 5. C. Hyde and W. H. Duckworth. July 15, 1960. 16p. Contract AF33(616)-6238.

Densities up to 98% theoretical were obtained in MgO ceramics free-sintered at 2400 to 2900°F. The most sinterable powder resulted from calcining at 1100°F. Various MgO calcines sintered in flowing combustion gases exhibited lower sintered densities in general than did those sintered in still air or flowing hydrogen at 2400, 2750, or 3100°F for 1 hr. The sintered density of ceramics made from an MgO calcine increased with faster rates of heating to the sintering temperature. Grain growth apparently was not affected by heating rate in the ranges examined, 50 to 400°F per hr. The densities of sintered compacts made from the same calcine increased greatly when the uniaxial compacting pressure was increased from 10,000 to 20,000 psi or when the isostatic compacting pressure was increased from 20,000 to 40,000 psi. (See also NP-8039.) (C.J.G.)

25941 NP-9130

Detroit Edison Co., Detroit.

THERMAL CYCLING EXPERIMENTS ON FUEL AND BLANKET ELEMENTS TO DETERMINE THE EFFECT OF PHASE TRANSFORMATION ON PHYSICAL SIZE AND MICROSTRUCTURE. Engineering Research Department Report 59E09-2. Jack J. Bodzin. Mar. 14, 1960. 10p.

Results are given of thermal cycling specimens of gamma-stabilized U-10 wt. % Mo pins and sections of U-2 $\frac{3}{4}$ wt. % Mo blanket elements between 475 and 675°C for 46 hrs. The alloys were cycled from the gamma to gamma-plus-alpha-plus-epsilon phases, and back to gamma. (J.R.D.)

25942 NP-9131

Detroit Edison Co., Detroit.

THERMAL CYCLING EXPERIMENTS ON BLANKET ELEMENTS AND FUEL PINS TO DETERMINE THE EFFECT OF CYCLING IN THE ALPHA-PLUS-EPSILON PHASE ON PHYSICAL SIZE AND MICROSTRUCTURE. Engineering Research Department Report 59E09-3. Jack J. Bodzin. Mar. 21, 1960. 10p.

Results are given of thermal cycling uranium-molybdenum fuel pins in the alpha-plus-epsilon phase between room temperature and 525°C for 700 cycles. A blanket-element sample that had previously been thermally cycled between the gamma and alpha-plus-epsilon phases was also included in the test for 156 cycles. (J.R.D.)

25943 NP-9135

Northwestern Univ., Evanston, Ill. Technological Inst. THE ELECTRICAL CONDUCTIVITY OF NEAR-STOICHIOMETRIC α -Nb₂O₅. Technical Report No. 1.

E. H. Greener, D. H. Whitmore, and M. E. Fine. [1960]. Project No. 032-459. Contract NONR-1228(16).

The electrical conductivity of α -Nb₂O₅ monocrystalline and sintered specimens, measured under a constant ambient oxygen pressure at 300 to 900°C, exhibits an exponential temperature dependence with an activation energy of 1.65 ev. The isothermal conductivity, σ , of near-stoichiometric α -Nb₂O₅ is related to the ambient oxygen partial pressure, P_{O_2} , by the power law expression $\sigma = \text{Const. } P_{O_2}^{0.24 \pm 0.01}$. Both sets of observations may be rationalized on the basis that slightly reduced α -Nb₂O₅ becomes a metal-excess n-type semiconducting oxide containing oxygen vacancies capable of trapping electrons. A detailed analysis of the relation between conductivity and ambient oxygen pressure indicated that the conductivity dependency may be ascribed to a mechanism whereby defect levels (due to oxygen-ion vacancies with either one or two trapped electrons) are created and electrons are thermally excited from these levels into the conduction band. (auth)

25944 NP-9175

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

PHASE DIAGRAMS OF SOME PLUTONIUM ALLOY SYSTEMS. D. M. Poole, M. G. Bale, P. G. Mardon, J. A. C. Marples, and J. L. Nichols. [1960]. 24p.

[Presented at the] International Conference on Metallurgy of Plutonium, Grenoble, April 19-22, 1960.

Complete or partial phase diagrams of plutonium binary systems with Zr, Ti, Co, Np, and La are presented. These data are also compared with other published data. (auth)

25945 NP-9178

Battelle Memorial Inst., Columbus, Ohio.

STUDIES OF MOLYBDENUM-, TUNGSTEN-, AND CHROMIUM-BASE ALLOYS WITH IMPROVED DUCTILITY. W. D. Klopp, F. C. Holden, and R. I. Jaffee. Aug. 31, 1960. 34p. Contract Nonr-1512(00).

A study was conducted on rhenium-free alloys of molybdenum, tungsten, and chromium to duplicate the beneficial effect of rhenium on properties of these alloys. Twinning and reduction of interstitial solubilities were promoted by platinum-metal additions, while osmium, tantalum, and columbium changed the nature of the intergranular oxides. Improvements in the fabricability of cast molybdenum were promoted by platinum-metal additions, particularly by osmium. These additions strengthened molybdenum but also increased the ductile-to-brittle bend transition temperature. (auth)

25946 NP-9183

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England and Oxford Univ. Clarendon Lab.

SOME PROPERTIES OF PLUTONIUM AND PLUTONIUM-RICH ALLOYS. J. A. Lee, G. T. Meadon, R. O. A. Hall, and E. King. [1960]. 22p.

[Presented at the] International Conference on Metallurgy of Plutonium, Grenoble, April, 19-22, 1960.

A short account is given of some recent electrical resistivity, lattice parameter and thermoelectric power measurements on plutonium and certain plutonium-rich binary alloys. The results are discussed briefly. (auth)

25947 NP-9185

Carborundum Co. Research and Development Div., Niagara Falls, N. Y. DEVELOPMENT OF ULTRA REFRACTORY MATERIALS. Progress Report No. 22 [for] May 1, 1960 through July 31,

1960. Peter T. B. Shaffer. Aug. 12, 1960. 9p. Contract NORD-17175.

The preparation and annealing of ZrC-TaC, ZrC-NbC, and TiC-ZrC are discussed. Lattice constants of the systems are given. (W.D.M.)

25948 NP-9200

Research Chemicals, Inc., Burbank, Calif.

REFRACTORY GADOLINIUM AND HAFNIUM COMPOUNDS. Monthly Report for the Period June 1 to June 30, 1959. 6p. Contract NObs-77145.

Resistivity measurements were made on antimony-gadolinium and bismuth-gadolinium alloys at 25°C. An arc-melting furnace for homogenizing the antimony-gadolinium alloy is described. The preparation of compounds in the gadolinium-selenium system is described. (See also NP-8872.) (C.J.G.)

25949 NP-9225

Canada. Dept. of Mines and Technical Surveys. Mines Branch.

EFFECT OF CASTING TEMPERATURE ON ALUMINUM ALLOY TEST BAR PROPERTIES. J. W. Meier and A. Couture. Feb. 1959. 50p.

Available as Can. Dept. Mines and Tech. Surveys, Mines Branch Research Rept. R-54. \$0.25.

After a recapitulation of the role of separately cast test bars in checking the melt quality and the response to heat treatment, a general review is presented of the effects of pouring temperature, maximum melt temperature, and prolonged holding time on the properties of aluminum sand-casting alloys. Separately cast test bars can be used successfully for melt-quality evaluation only if they are cast under standardized and strictly controlled conditions. To accomplish this, they should be cast at the most suitable temperature, independently of the pouring temperature of the production castings. The effect of various pouring temperatures on the mechanical properties, the grain size, and the porosity (density) of separately cast test bars in six commonly used commercial alloys was investigated. Additionally, consideration was given to the effects of overheating of the melt and of prolonged holding times at three temperature levels. The results showed that higher pouring temperatures affected markedly (although in varying degrees) the properties of alloys C4, G10, S5, and SC51, but had little or no effect on alloys SG70 and ZG61. Overheating or prolonged holding times had no lasting effect on the properties of alloys S5, SC51, SG70, and ZG61, provided a proper pouring temperature was used. Properties of bars from overheated alloy C4 melts could not be completely restored, and no recovery whatever could be obtained for alloy G10 melts. It was concluded that the maximum melt temperature and the pouring temperature for separately cast test bars in alloys C4 and G10 should not exceed 720°C (1330°F), if consistent and comparable results are to be expected. For the other alloys, the use of a standardized pouring temperature (or temperature range) is essential to ensure effective melt-quality control. (auth)

25950 NP-9226

Canada. Dept. of Mines and Technical Surveys. Mines Branch.

EFFECT OF HIGH TEMPERATURES ON CONCRETES INCORPORATING DIFFERENT AGGREGATES. N. G. Zoldners. May 1960. 54p.

A condensed version of this report was presented as a paper at the Annual Meeting of the American Society for Testing Materials, Atlantic City, N. J., on June 30, 1960.

Available as Can. Dept. Mines and Tech. Surveys, Mines Branch Research Rept. R-64. \$0.25.

Changes in physical properties of concrete beams and cylinders made with gravel, sandstone, limestone, and expanded-slag aggregates were studied after exposure to various temperatures ranging from 100 to 800°C. Results indicated that the residual compression strength of concrete increased up to 10% when the specimens were heated up to 300°C, whereas the flexural strength decreased 34% with limestone and 55% with gravel aggregate. After 500°C exposure, losses in strength of corresponding concretes were 19 to 24% in compression and 58 to 80% in flexure. In temperatures over 500°C the residual strength of all types of concrete decreased sharply due to dehydration of chemical constituents in the cement paste. Results from the four types of concrete investigated indicate that limestone concrete gave the best performance up to 700°C, at which temperature decomposition of carbonates on the surface of test specimens was observed. (auth)

25951 NRL-5507

Naval Research Lab., Washington, D. C.

CRACK PROPAGATION TESTS OF HIGH-STRENGTH SHEET MATERIALS. PART V. AIR-MELTED AND CONSUTRODE AMS 6434 STEEL. C. D. Beachem and J. E. Srawley. May 2, 1960. 22p. Project RR 007-01-42-5405.

Previous reports in this series issued as NRL-5127; NRL-5263; NRL-5348; and NRL-5460.

Crack propagation tests were conducted on air-melted and consumable-electrode vacuum-remelted SAE Aeronautical Materials Specification 6434 (modified AISI 4335 with vanadium), using specimens $\frac{1}{2}$ in. or $1\frac{1}{2}$ in. wide and up to 0.125 in. thick, and heat-treated to have yield strengths in the range 180 to 210 ksi. The full shear temperatures obtained with the different thicknesses and heat treatments were lower than those of any other steels of comparable thicknesses and yield strengths that have been tested to date, and the net fracture-stress values were similarly superior. The consutrode material was significantly better than the air-melted material. Limited data indicated that the transverse properties were not significantly inferior to the longitudinal properties. The FST was higher for thicker material, as previously observed for other materials. Austenitizing at 1620°F gave better results than at 1575°F, and tempering at 400°F gave better results than at 725°F. (auth)

25952 TID-6578

Colorado. Univ., Boulder.

RESEARCH ON METALS AND ALLOYS AT LOW TEMPERATURES. Report No. 5 [for] September 1, 1959 to July 1, 1960. William F. Love. Aug. 1960. 50p. Contract AT(11-1)-377. OTS.

Transverse galvanomagnetic measurements, based on a theorem of van der Pauw, were made in n-InSb at 30 to 300°K. Measurements of transverse magnetoresistance were made in bismuth single crystals at 15 to 290°K. Above 70°K, the temperature dependence of the specific resistance was linear; below 70°K, the behavior was nonlinear and approached a $T^{1.6}$ relationship at 15°K. The apparatus and method for studying the de Haas-van Alphen effect in crystals by an oscillographic high-field technique are described. (auth)

25953 WADC-TR-59-762(Pt.II)

American Machine and Foundry Co., Alexandria, Va.

ULTRA-SHORT-TIME CREEP RUPTURE. [Period covered]: February 2, 1959 to October 31, 1959. Joseph S. Ives, Jr. Nov. 1959. 130p. Project No. 7381. Contract AF33(616)-5557. OTS.

The short-time creep behavior of eight structural sheet

materials when subjected to temperatures up to 2000°F was determined for time periods of 10 sec to 3 min. The test specimens were preloaded and subsequently heated to the desired test temperature within 100 msec through capacitance discharge. Test temperature was then maintained by an a-c current. Strain-time, isochronous stress-strain, and stress-time curves are presented. Initial transient behavior due to thermal expansion is also reported. (auth)

25954 WADD-TR-60-132

Nuclear Metals, Inc., Concord, Mass.

REFRACTORY METAL CONSTITUTION DIAGRAMS. Period covered: July 1958 to June 30, 1960. A. R. Kaufmann, E. J. Rapperport, M. F. Smith, J. Wulff, J. Brophy, N. J. Grant, B. C. Giessen, A. Taylor, and N. Doyle. June 30, 1960. 197p. Project No. 8(8-7351). Contract AF33(616)-6023. (NMI-9216). OTS.

Nine binary constitution diagrams and one ternary constitution diagram of some of the refractory metals are presented. The binary diagrams include: Hf-Mo, Hf-W, Nb-Re, Os-Ta, Re-Ta, Ru-Ta, Ru-W, and Re-Ta-W. (auth)

25955 WAL-TR-805/34

Watertown Arsenal Lab., Mass.

THE DUCTILITY TRANSITIONS OF BODY-CENTERED CUBIC METALS. F. R. Larson. Jan. 1958. 12p. DA Project No. 5 B93-32-002.

Reviews of previously published data revealed that there are two types of ductility transitions for body-centered cubic metals, i.e., reduction of area and uniform elongation. Differences between these two ductility transitions are discussed. (C.T.G.)

25956 WCAP-1596

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

THERMOELECTRIC NUCLEAR FUEL ELEMENT QUARTERLY PROGRESS REPORT FOR APRIL-JUNE 1960. W. P. Blankenship, R. C. Goodspeed, R. A. Markley, and P. V. Mitchell. July 10, 1960. 53p. Contract AT(30-3)-500. OTS.

A hot-pressing system was designed and is adaptable for bomb melting experiments up to 2000°C. Two devices were constructed for measuring. One was designed to measure Seebeck coefficients, resistivities, and bond resistances of swaged and machined thermoelectric wafers and the other was designed to measure thermoelectric parameters of cylindrical thermoelectric pellets up to 1000°C. Design studies on a fission-fired thermoelectric generator were completed. Seebeck coefficient and resistivity were determined for $\text{Li}_{0.98}\text{Ni}_{1.04}$ and p type PbTe as a function of thermal flux at 400°C (average). Designs of prototype thermonuclear fuel elements are presented which include single-leg, double-leg, multi-junction notched-bar, and multi-junction pelletized designs. The effects of heat-treatment on the thermoelectric properties of n and p type PbTe were determined at 68°F. The compatibility of PbTe and GeTe with cladding materials was investigated at 510, 600, and 650°C. The results of life testing a swaged single-leg GeTe element are discussed. The nuclear characteristics of a 500-kw thermoelectric core that employs a rod-type fuel element were calculated. Designs of a thermoelectric reactor system that utilizes thermal circulation are presented. (For preceding period see WCAP-1545.) (C.J.G.)

25957 AEC-tr-4173

KINETICS OF PHASE TRANSFORMATION OF U-Pu-Mo ALLOYS. René Boucher. Translated from Report No. 19 [presented at] "International Conference on Plutonium Metallurgy, Grenoble, April 19-22, 1960." 23p. JCL.

Phase transformation of three uranium-plutonium-molybdenum alloys were studied. The alloys consisted of 72, 70, and 68% uranium-20% plutonium-8, 10, and 12% molybdenum. It was observed in the case of the two alloys containing the highest % of molybdenum that decomposition of the gamma phase produced dilatation of the samples between 550 and 400°C, and a contraction below 400°C. Only the alloy containing 8% molybdenum undergoes a contraction at all decomposition temperatures studied. The amplitude of the phenomena observed by dilatometry is small, even in the case of the alloy at 8% molybdenum, during isothermal decomposition. The velocities of decomposition are rather slow and can produce no abrupt variation in reactivity inside a reactor. The alloys hold very well during the thermal cycles worked out during the dilatometric study. (W.L.H.)

25958 AEC-tr-4204

THE MORPHOLOGY OF PRECIPITATES IN STAINLESS STEEL STABILIZED WITH TITANIUM. Vladimir Cihál and Jaroslav Jezek. Translated from *Hutnické listy* 11, No. 3, 151-3(1956). 7p. JCL.

The tendency of chrome-nickel steels to intercrystalline corrosion was investigated. Morphology and structure of precipitating carbides in 18/8 steels stabilized with titanium were investigated. (auth)

25959 AEC-tr-4220

PREFERRED DIRECTION OF SURFACE DIFFUSION ON SINGLE-CRYSTAL FACES. M. Drechsler. Translated by Robert Andelin and Gretchen R. Riese (Los Alamos Scientific Lab.) from *Z. Elektrochem.* 58, 334-9(1954). 18p. JCL.

Preferred directions of surface diffusion are ascertained theoretically for the surfaces of body-centered cubic crystals. According to two methods with the field electron microscope, the oriented surface migration, etc., was established for the systems Ba on W and W on W. Calculated and measured results agree over-all. In addition it was shown that adatoms go beyond the edge of a surface preferentially at sections of slight border energy. (auth)

25960 AEC-tr-4224

DIFFUSION IN TUNGSTEN WITH LOW IRON CONTENT. J. A. M. van Liempt. Translated by Robert Andelin and Gretchen Riese (Los Alamos Scientific Lab.) from *Rec. trav. chim.* 64, 239-49(1945). 17p. JCL.

The diffusion of iron in a tungsten alloy containing 0.04% iron was measured at 2200 to 2800°C. A formula was derived to approximate the reciprocal diffusion coefficient; the results are compared to the approximations of Dünwald and Wagner. (C.J.G.)

25961 AEC-tr-4231

THE PROBLEM OF USING TITANIUM TO STABILIZE ANTICORROSION STEEL 18/9 FOR CASTINGS. Rudolf Pospisil and Rudolf Stefec. Translated from *Hutnické listy* 11, 218-25(1956). 13p. JCL.

Requirements for stabilization of shaped steel in terms of its capacity for welding and uses are reviewed. The effects of titanium additions are examined, and results of experiments with two different melts are presented. Stabilization annealing is discussed along with experimental results and conclusions. (J.R.D.)

25962 AEC-tr-4241

France. Commissariat à l'Energie Atomique, Paris. X-RAY DIFFRACTION STUDY OF γ PHASE FORMATION IN U-Mo ALLOYS. (Etude par Diffraction des Rayons X de la Formation de la Phase Gamma dans les Alliages U-Mo). G. Donze. 1959. Translated from report CEA-1231. 9p. JCL or LC.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 11971.

25963 CEA-tr-I-33

ETUDE SUR LE BÉRYLLIUM. I. PROPRIÉTÉS DU BÉRYLLIUM À HAUT DEGRÉ DE PURETÉ. (Study of Beryllium. I. Properties of Very-Pure Beryllium). L. Losana. Translated into French by L. Roulet from Alluminio 8, 67-75(1939). 44p.

The methods for obtaining beryllium of a high degree of purity are given, and a study is reported of the uncertain or not well-known physico-chemical properties of beryllium thus produced. The specific gravity, melting point, specific heat, heat of fusion, thermal expansion, thermoelectric properties, hardness, and x-ray transparency are given. The very important variation in properties with purity within narrow limits is shown. An anomaly between 600 and 700°C was found which could be an allotropic modification of beryllium. (T.R.H.)

25964 CEA-tr-R-820

ÉTUDE PAR DIFFRACTION ÉLECTRONIQUE DE LA STRUCTURE DES MÉTAUX ET ALLIAGES À L'ÉTAT LIQUIDE. (Electron Diffraction Study of the Structure of Metals and Alloys in the Liquid State). A. I. Bublik (Boublík) and A. G. Buntar (Bountar). Translated into French from Kristallografiya 3, No. 1, 32-42(1958). 27p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 16250.

25965 CEA-tr-R-826

FRAGILISATION DE L'ACIER PAR L'HYDROGÈNE DANS LES SOLUTIONS D'HYDROGÈNE SULFURÉ. (Hydrogen Embrittlement of Steel in Hydrogen Sulfide Solutions). S. A. Balesin (Balesine) and I. V. Nikolskii (Nikolsky). Translated into French from Zhur. Priklad. Khim. 31, 1181-4(1958). 12p.

Embrittlement by hydrogen appeared in steel during cleaning in an aqueous H_2S solution. The formation of this embrittlement by H_2 in H_2O in the presence of a film of sulfur on the surface was demonstrated. A possible explanation is offered. (T.R.H.)

25966 NP-tr-492

INVESTIGATION OF ZIRCONIUM BORIDE-MOLYBDENUM ALLOYS. (Doslidzheniya Splaviv Boridu Tsirkoniyu z Molibdenom). M. S. Koval'chenko, V. S. Neshpor, and G. V. Samsonov. Translated from Dopovidi Akad. Nauk Ukr. R.S.R. No. 7, 740-2(1958). 8p. OTS.

The alloys of a ZrB_2 -Mo system obtained by sintering were investigated. A hypothetical ZrB_2 -Mo system diagram was obtained by means of visual, thermal, metallographic, and roentgenographic analyses and by measuring the micro- and macrohardness. The existence of a tertiary boride, Mo_2ZrB_2 , was found in the system. (auth)

25967 UCRL-Trans-583(L)

A MASS SPECTROMETER STUDY OF ION EMISSION FROM THE ALUMINUM SILICATES. J. Beaussier and G. Couchet. Translated by W. D. Kilpatrick from Compt. rend. 236, 1417-19(1953). 4p. JCL.

Spectrometric studies revealed that ion emission from aluminum silicates consists of the positive ions: K^{39} , K^{41} , Na^{23} , Li^7 , and Li^6 . Variation of emission was studied as a function of time, temperature, and acceleration voltage. (C.J.G.)

25968

THE THERMODYNAMICS OF THE CHROMIUM-IRON SYSTEM. O. Kubaschewski and G. Heymer (National

Physical Lab., Teddington, Eng.). Acta Met. 8, 416-23 (1960) July.

A method for the determination of the vapor pressure of chromium was devised by combining Knudsen's effusion method with tracer analysis using Cr^{51} with a half life of 27.8 days. The vapor pressures determined in the temperature range 1170 to 1400°C agree with previous work and may be represented by the equation $\log p_{atm} = -19,700/T + 6.92$. The heat of sublimation at 298°K is 94.0 kcal/g-atom; the boiling point is estimated to be 2680°C. The chromium pressures in the system chromium-iron were measured at 1340 to 1370°C for various compositions. The activity curve shows some positive deviation from Raoult's line. Assuming the solid and liquid solutions to be regular; and by the use of thermal data for the minimum in the liquidus curve and the maximum of the σ - α transformation together with Backhurst's atomic heat data for this transformation, the phase boundaries, α -liquid and α - σ , were calculated and found to agree essentially with the experimental phase diagram. The solid-liquid gap was, however, found to be narrower than had been assumed, and the α - σ boundary was extended to lower temperatures. (auth)

25969

ON THE PHASES OF THE CHROMIUM-NICKEL-NIOBIUM SYSTEM. V. N. Svechnikov and V. M. Pan (Inst. of Physics of Metals, Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk Ukr. R.S.R. No. 5, 634-7(1960). (In Ukrainian)

The chromium-nickel-niobium system was investigated on high-purity alloys within a range of up to 50% niobium by weight. Quasibinary sections were constructed in the examined part of the ternary system, as well as isothermal sections at 1100 and 1175°C. A new ternary intermetallic compound was discovered, with a composition approximately corresponding to the formula $Ni_3Cr_5Nb_2$. This compound crystallized from the liquid state at $1175 \pm 5^\circ C$, and disintegrated at $1160 \pm 5^\circ C$, undergoing eutectoid transformation. (auth)

25970

EFFECT OF CHEMICAL ACTIVATION AND ELECTRODIALYSIS ON THE COMPOSITION AND STRUCTURE OF MONTMORILLONITE. F. D. Ovcharenko and I. I. Martsin (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk Ukr. R.S.R. No. 5, 649-54(1960). (In Ukrainian)

On the basis of a chemical, roentgenostructural, and an electronmicroscopic analysis, a substantial change in the composition of montmorillonite was established as a result of activation, during which oxides of Al, Fe, Ca, and Mg as well as hydrate water were removed from the crystalline lattice, thus leading to a 13% rise in the free SiO_2 content. Electrodialysis intensified the process, increasing SiO_2 by another 4%. The observed transition of the indicated oxides was connected with a change in the structure of the crystalline lattice, during which the distance between the basal planes and the porosity of the specimen were increased, resulting generally in a rise in the adsorptive capacity of the activated clays. (auth)

25971

TEMPERATURE DEPENDENCE OF THE ADIABATIC ELASTIC MODULI OF SINGLE-CRYSTAL ALPHA URANIUM. H. J. McSkimin (Bell Telephone Labs., Murray Hill, N. J.) and E. S. Fisher. J. Appl. Phys. 31, 1627-39 (1960) Sept.

The ultrasonic-wave velocities in small α -uranium single crystals were measured at various temperatures using the phase-comparison technique. Details in the experimental procedure, direct computation of the stiffness

moduli, and cross-checking by indirect methods are given. The temperature dependence of the moduli are reported for the range -195 to $+300^{\circ}\text{C}$ for c_{11} , c_{22} , and c_{33} and -195 to $+35^{\circ}\text{C}$ for the remaining 6 principal moduli. The results show a very marked abnormal temperature dependence of the elasticity in the $[100]$ direction; c_{11} decreases with temperatures below -17.2°C , and the linear compressibility in $[100]$ increases from $+35$ to -195°C . The bulk modulus passes through a maximum at -100°C . These abnormalities indicate a strong temperature dependence of the electron interactions involved in the second nearest-neighbor bond. (auth)

25972

THE THERMAL EXPANSION OF DELTA AND EPSILON ZIRCONIUM HYDRIDES. Charles P. Kempter, Reed O. Elliott, and Karl A. Gschneidner, Jr. (Los Alamos Scientific Lab., N. Mex.). *J. Chem. Phys.* **33**, 837-40(1960) Sept.

The thermal expansion characteristics of polycrystalline delta (face-centered-cubic) zirconium hydride and epsilon (body-centered-tetragonal) zirconium hydride were determined between room temperature and 362 and 300°C , respectively, by means of x-ray diffraction techniques. The average linear thermal expansion coefficient for the delta phase is $2.98 \times 10^{-6}/^{\circ}\text{C}$ for the range 24 to 362°C . For the epsilon phase, the average coefficients for the range 24 to 300°C are $-1.4 \times 10^{-6}/^{\circ}\text{C}$ and $30.6 \times 10^{-6}/^{\circ}\text{C}$ for the a and c directions, respectively, and $9.3 \times 10^{-6}/^{\circ}\text{C}$ for the randomly oriented polycrystalline material. (auth)

25973

CREEP-RESISTANT MAGNESIUM ALLOYS FOR NUCLEAR FUEL ELEMENTS. G. C. E. Olds (Associated Electrical Industries (Rugby) Ltd., Aldermaston, Berks, Eng.) and G. M. Michie. *J. Inst. Metals* **88**, 493-9(1960) Aug.

An investigation was made of the creep properties at 450 to 500°C of extruded magnesium-base magnesium-manganese and magnesium-zirconium-manganese alloys with a view to their application as lightly stressed structural components. Binary alloys containing 0.75 to 1.0% manganese (AM503S) exhibit a high creep strength at low stresses only if submitted to a grain-coarsening treatment. This, however, results in poor rupture ductility; at higher stresses a better ductility, accompanied by a marked loss in creep strength, is found. When the manganese content is raised to 1.5% (AM503), a very high creep-resistance at 450°C is obtained in the as-extruded condition at a relatively small grain size. In ternary alloys containing 0.2 to 0.7% zirconium, 0.1% manganese imparts high creep strength at 450°C but results in a relatively poor creep strength at 500°C , which cannot be substantially improved by heat-treatment. A 0.3% manganese content imparts high creep-resistance at 500°C ; the best alloy is one that contains 0.7% zirconium. At high temperatures, the ternary alloys possess a relatively stable grain size and high-rupture ductility. (auth)

25974

THE CREEP AND HIGH-TEMPERATURE FATIGUE PROPERTIES OF THE MAGNESIUM-BASE CANNING ALLOY, MAGNOX A.12. P. E. Brookes, N. Kirby, and W. T. Burke (United Kingdom Atomic Energy Authority, Culcheth, Lanes, Eng.). *J. Inst. Metals* **88**, 500-8(1960) Aug.

A study was made of the creep ductility and high-temperature fatigue behavior of the magnesium-base alloy Magnox A.12, currently used as the canning material in the Calder Hall and Chapelcross reactors. Particular attention was given to creep behavior in the lower range of reactor temperatures where this alloy exhibits its minimum ductil-

ity and where intergranular cavitation is most prevalent. The effects of temperature, strain rate, and grain size on both ductility and cavitation were investigated. In view of the lack of data on the high-temperature fatigue strength of this alloy, a preliminary survey was made over the range 225 to 500°C . Detailed studies were carried out at 400 and 450°C where the fatigue strength attained its lowest value. With the exception of very short-term tests in which general cracking occurred, fatigue failure was attributable to the development of intergranular cavities and their subsequent interlinking. The effect of initial grain size and grain growth during test was studied at 400 to 500°C . It is shown that grain coarsening gives rise to increased fatigue strength at these temperatures. (auth)

25975

THE MECHANICAL PROPERTIES OF SOME DUCTILE NIOBIUM AND TANTALUM BASE ALLOYS PREPARED BY ELECTRON BEAM MELTING. H. R. Smith, Jr., J. Y. K. Hum, A. Donlevy, and C. d'A. Hunt (Temescal Metallurgical Corp., Richmond, Calif.). *J. Less-Common Metals* **2**, 69-75(1960) Apr.-Aug. (In English)

The results of studies made on a relatively small number of niobium and tantalum base alloys are presented. Using impact transition temperature as a criterion for initial evaluation, a number of alloys were selected for high temperature tensile and creep rupture tests and fabrication studies. These data are being obtained at the present time, and more complex modifications of these alloys are being explored. Tantalum alloys containing more than 20% tungsten are very brittle and this limits the usefulness of the combination. Present investigations are directed toward the development of more complex alloys to take advantage of the exceptional ductility exhibited by tantalum base alloy systems. Niobium alloy development is still in its infancy. Although the electron beam process restricts the number of combinations of alloying elements that can be used, there is a good possibility that, in addition to tungsten, molybdenum, and zirconium, rhenium and hafnium may materially improve high temperature properties. Economic reasons restrict the amounts of these latter two additions that can be used at present. Although at other laboratories there are higher strength niobium alloys being prepared than the ones discussed here, they are considerably less fabricable and ductile. The efforts of this investigation were directed toward the development of alloys with good fabricability rather than stronger alloys with severe fabrication problems. (auth)

25976

NIOBIUM AND TANTALUM ALLOYS. A. G. Knapton (Associated Electrical Industries, Aldermaston, Berks, Eng.). *J. Less-Common Metals* **2**, 113-24(1960) Apr.-Aug. (In English)

Recently published work on niobium and tantalum alloys is reviewed. This is followed by a consideration of the strain energies associated with solid solution formation in some binary systems, which shows that the strain energy contribution may account for differences in alloying behavior between certain niobium and tantalum alloys. Original work on several niobium and tantalum systems is described. (auth)

25977

ON THE FORMATION OF INTERMEDIATE PHASES IN ALLOYS OF Nb, Ta, Mo, AND W WITH OTHER TRANSITION METALS. C. W. Haworth (Univ. of Sheffield, Eng.). *J. Less-Common Metals* **2**, 126-30(1960) Apr.-Aug. (In English)

Certain phases found in transition metal alloys are de-

scribed. The type of structure formed and the manner in which the various atomic sites are occupied is interpreted in terms of atomic size and valency effects. (auth)

25978

NITRIDES, CARBONITRIDES, AND OXYNITRIDES OF NIOBIUM. G. Brauer (Universität, Freiburg i. B.).

J. Less-Common Metals **2**, 131-7(1960) Apr.-Aug. (In English)

Methods of preparing niobium nitrides and oxynitrides are described. The stability of the different phases were thoroughly investigated. A survey of the carbonitrides of niobium is given, and some of their properties are described. (auth)

25979

THE PHASE CONSTITUTIONS OF SOME NIOBIUM-BEARING AND ASSOCIATED TRANSITION METAL SYSTEMS. H. J. Goldschmidt (B. S. A. Group Research Centre, Birmingham, Eng.). *J. Less-Common Metals* **2**, 138-53(1960) Apr.-Aug. (In English)

A constitutional survey is given of niobium-bearing ternary systems, and the underlying principles are discussed in some of their broader aspects. The systems represent substantially solid-solution and compound-controlled types. Miscibility bay formation is an important variant to the first, implying coherent segregation effects and strain-hardening. The second can exhibit some complex phase assemblies and new compounds; although brittle, alloys of this type may still yield valuable properties like oxidation resistance. Fundamentally niobium systems are viewed only as part of the surrounding transition metal unity in the periodic table, and non-equilibrium states obtain a special practical significance. (auth)

25980

THE PHYSICAL PROPERTIES OF NIOBIUM, TANTALUM, MOLYBDENUM, AND TUNGSTEN. B. B. Argent and G. J. C. Milne (Univ. of Sheffield, Eng.). *J. Less-Common Metals* **2**, 154-62(1960) Apr.-Aug. (In English)

The physical properties of niobium, tantalum, molybdenum, and tungsten are reviewed in relation to the properties of the other elements of groups IVa, Va, and VIa of the periodic table. Zone-refined specimens of niobium and tantalum were prepared, and resistivity, magnetic susceptibility, and thermal emf measurements were made at 10 to 295°K. (auth)

25981

UNITED STATES AIR FORCE PROGRESS REPORT ON REFRACTORY METALS. H. A. Johnson, C. S. Hartley, and M. D. McNabb (Wright-Patterson Air Force Base, Ohio). *J. Less-Common Metals* **2**, 204-17(1960) Apr.-Aug. (In English)

A cross-section of the research and development activities of the U. S. Air Force in the refractory metals area is presented. Emphasis is being placed on the development of high-strength alloys for structural applications at temperatures in excess of 1100°C. Studies of the oxidation behavior of tantalum and tungsten are being conducted concurrently with research on protective coatings. A refractory metals processing facility was established and limited programs were conducted on the primary breakdown of arc-cast tungsten and molybdenum base alloys by extrusion. (auth)

25982

DEFORMATION, FRACTURE, AND RADIATION DAMAGE, IN BODY-CENTRED CUBIC TRANSITION METALS. A. A. Johnson (Imperial Coll. of Science and Tech., London). *J. Less-Common Metals* **2**, 241-52(1960) Apr.-Aug. (In English)

Advances in the dislocation theory of the deformation and fracture of body-centered cubic transition metals are reviewed. The theory is still largely phenomenological and is formulated in terms of the parameters σ_1 and k_y in the empirical relation $\sigma_y = \sigma_1 + k_y d^{-1/2}$ between yield stress and grain diameter. The application of the theory to body-centered cubic transition metals other than iron and steel is hindered by the absence of reliable values of σ_1 and k_y . Recent values obtained for molybdenum and niobium explain why the ductile-brittle transition temperature of molybdenum is much higher than that of niobium. Experiments on the recovery of the electrical resistivity of deformed niobium, molybdenum, tantalum, and tungsten wires showed that point defects, believed to be lattice vacancies, are created during deformation near room temperature. The activation energies for the diffusion of the vacancies are 1.0, 1.3, 1.35, and 1.7 eV for niobium, molybdenum, tantalum, and tungsten, respectively. Similar measurements were made on neutron-irradiated niobium, molybdenum, and tungsten. The results obtained agree well with those of the deformation experiments. It was shown that the annealing of vacancies in irradiated niobium and molybdenum is accompanied by an increase in yield stress. (auth)

25983

MECHANICAL PROPERTIES ATTAINABLE BY ALLOYING OF REFRACTORY METALS. B. S. Lement (Manufacturing Labs., Inc., Cambridge, Mass.) and I. Perlmutter. *J. Less-Common Metals* **2**, 253-71(1960) Apr.-Aug. (In English)

The status of mechanical properties of W, Mo, Ta, and Nb-base alloys as of April 1960 is discussed. Basic metallurgical considerations with respect to high temperature strength, ductility, and transition temperature are covered. The mechanical properties at elevated temperatures attainable by both artificial dispersoid systems and regular alloy systems are presented and discussed from the standpoint of dispersion, solid solution, and strain hardening. On the basis of elevated temperature strength, the order of decreasing superiority is W, Mo, Ta, and Nb-base alloys; whereas on the basis of strength-weight ratio, this order is Mo, W, Nb, and Ta-base alloys. (auth)

25984

COMPRESSION CREEP TESTS ON NIOBIUM AT HIGH TEMPERATURES. G. Brinson (Univ. of Sheffield, Eng.). *J. Less-Common Metals* **2**, 272-6(1960) Apr.-Aug. (In English)

A description is given of a machine for measuring creep in compression at high temperatures in a vacuum of about 10^{-6} mm Hg. The design is such that the maximum temperature of testing is limited mainly by the creep strength of the push rods; rods of recrystallized alumina are satisfactory at 1200°C. Creep curves are given for a commercial grade of niobium. (auth)

25985

ON THE INFLUENCE OF SMALL ADDITIONS OF NON-METALS ON THE SINTERING, WORKING AND THE MECHANICAL PROPERTIES OF TUNGSTEN. H. Braun and K. Sedlatschek (Metallwerk Plansee, Reutte, Tyrol, Austria). *J. Less-Common Metals* **2**, 277-91(1960) Apr.-Aug. (In English)

The influence of 0.01 to 1.0 wt. % of various elements on the sintering behavior, the workability, and the mechanical properties of tungsten was examined. Carbon, boron, tungsten boride (W_2B), tungsten silicide (W_3Si_2), aluminum, beryllium, titanium, zirconium, hafnium, thorium, vanadium, and chromium were used as additives. Changes in

the as-sintered density and hardness, workability by hot-rolling, hardness, transverse rupture strength, and ductility (deflection on transverse bending) of worked alloys were determined and related to the concentration of alloying elements. The effects of the added elements are considered in relation to the formation of volatile or solid refractory deoxidation products. Further work necessary to substantiate the limited data is suggested. (auth)

25986

EFFECT OF HYDROGEN ON DISLOCATION LOCKING IN NIOBIUM. B. A. Wilcox (Wright-Patterson Air Force Base, Ohio) and R. A. Huggins. J. Less-Common Metals 2, 292-303(1960) Apr.-Aug. (In English)

The strain-aging tendencies of as-received commercial purity arc-melted niobium and hydrogenated niobium from the same heat were investigated using yield point return and dynamic modulus measurements to study the aging process. Comparison of activation energies for strain aging with those for interstitial diffusion revealed that hydrogen could be responsible for dislocation locking in niobium. In order to obtain a measure of the degree of dislocation locking as a function of hydrogen content, the lower yield stress of electron-beam melted niobium (both as-received and hydrogen-charged) was measured as a function of grain diameter, using a constant strain rate and test temperature. In the equation $\sigma_y = \sigma_1 + k_y d^{-1/2}$, the parameter σ_1 was found to be relatively insensitive to hydrogen content, and the parameter k_y , a measure of the locking strength, was found to increase with increasing hydrogen content. (auth)

25987

MAGNETOSTRICTION OF YTTRIUM IRON GARNET. Akira Nakamura and Yoshikazu Sugiura (Electrotechnical Lab., Tokyo). J. Phys. Soc. Japan 15, 1704(1960) Sept. (In English)

An adhesive strain gage was used to measure the magnetostriction of polycrystalline yttrium iron garnet. The relative change in length was plotted against the applied magnetic field. From this curve the saturation magnetostriction constant $\lambda_s = -(3.7 \pm 0.5) \times 10^{-7}$ was obtained. This small value appeared to be explained by dipolar interaction. (M.C.G.)

25988

THERMAL EXPANSION OF α -PLUTONIUM. N. T. Čebotarev and A. V. Beznosikova. Kernenergie 3, 561-2 (1960) June. (In German)

The expansion coefficients for α -plutonium in different directions between -196 and $+100^\circ\text{C}$ were determined. Roentgenograms were obtained for the wire form (0.5-mm diam.) samples at room temperature, liquid N_2 temperature, and 100°C . Satisfactory agreement with other results was found. (T.R.H.)

25989

DEPENDENCE ON TEMPERATURE OF THE INTERLAYER SPACING IN CARBONS OF DIFFERENT GRAPHITIC PERFECTION. E. G. Steward, B. P. Cook, and E. A. Kellett (General Electric Co., Ltd., Wembley, Eng.). Nature 187, 1015-16(1960) Sept. 17.

Thermal expansion in graphitic carbons perpendicular to the hexagonal layer planes was investigated. Measurements made at temperatures up to 2600°C indicated that whereas the rate of expansion is dependent on the interlayer spacing, it is not significantly dependent for a given spacing on stacking disorder. Measurements made at temperatures down to -196°C indicated that for carbons of different graphitic perfection there are different limiting distances of closest approach between the layers. The curves for in-

terlayer spacings vs. temperature show that whereas the high-temperature behavior is chiefly controlled by the interlayer spacing alone, the low-temperature rate of expansion for a given spacing is dependent on imperfections and stacking disorder effects. (M.C.G.)

25990

BURST TESTS HELP SET DESIGN STRESS FOR NPD PRESSURE TUBES. William A. Wolfe (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Nucleonics 18, No. 10, 96; 98; 100(1960) Oct.

Pressure tubes are basic features of both the NPD and CANDU. The tube design must promise adequate resistance to corrosion and adverse radiation effects and must promise the highest possible integrity for operating pressures and temperatures. An important factor in setting pressure-tube thickness is the allowable design stress. Calculations for the CANDU reactor show a saving of \$2 million or 0.1 mill/kwh if the design stress for its tube material (Zircaloy-4) is increased from 15,000 to 18,000 psi. The results of high-pressure burst tests have increased the confidence in Zircaloy-2 as a pressure-tube material and in the soundness of rolled joints between the Zircaloy tube and the stainless-steel end fitting. The strengths of Zircaloy-2 as obtained from burst and tensile tests are compared. (B.O.G.)

25991

ELECTRON MICROSCOPE STUDIES OF DISLOCATION STRUCTURES IN GRAPHITE. G. K. Williamson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Roy. Soc. (London) A257, 457-63(1960) Sept. 27.

Dislocations in a variety of single-crystal flakes of graphite (hexagonal crystal structure) were studied by transmission electron microscopy. All the dislocations observed were parallel to the layer plane with Burgers vectors in this plane. Dislocations occurred as pairs, approximately 1000 Å apart, with Burgers vectors of the type $\frac{1}{3}a(10\bar{1}0)$ giving together a unit lattice translation of a along one of the three coplanar hexagonal axes. The area between these two partials contained a stacking fault corresponding to the rhombohedral structure discussed by Lipson & Stokes. The stacking fault energy was shown to be $\sim \frac{1}{10}$ erg/cm² and to be substantially independent of temperature up to 900°C . Two interactions were observed; one was a direct one to form a network with extended and contracted nodes, and the other was an indirect one between dislocations on different slip planes and owing to the long-range stress fields of the dislocations. An asymmetry observed in the latter interaction can be explained by the different line tensions of edge and screw dislocations. All dislocations were glissile, and no interaction leading to sessile dislocations was found. (auth)

25992

THE STRUCTURE OF ELECTRODEPOSITED CHROMIUM. Masahisa Matsunaga. Sci. Papers Inst. Phys. Chem. Research (Tokyo) 54, 177-83(1960) June. (In English)

The crystal orientation and the degree of specular gloss of electrodeposited chromium were studied for deposits obtained at current densities from 10 to 100 amp/dm² and temperatures from 20 to 70°C by using three kinds of chromic acid baths. The brightest deposits are characterized by (111) preferred orientation as was shown by Yoshida, Hume-Rothery, and Wyllie. Diagrams are prepared showing the effect of temperature and current density on the degree of specular gloss and crystal orientation of the deposits. In addition to the well known (111) orientation, (110) and a modified (111) orientation are formed at high temperature. (auth)

25993

LATTICE CONSTANTS, EXPANSION COEFFICIENTS, DENSITIES, DEFECTS, AND STRUCTURE OF THE TITANIUM(II) OXIDE PHASE. M. E. Straumanis and H. W. Li (Univ. of Missouri, Rolla). *Z. anorg. u. allgem. Chem.* 305, 143-7(1960) July. (In German)

Five preparations of different composition (but all within the range of the homogeneous phase TiO) were made by sintering TiO₂ and Ti¹ mixtures at 1400°C, then homogenizing them at 1000°C and quenching from that temperature. For the TiO of stoichiometric composition a lattice constant of $a_{25} = 4.1766 \pm 0.0001$ Å was obtained; the linear-expansion coefficient is independent of the composition of the samples showing an average of $(7.6 \pm 2) \cdot 10^{-6}$; the macroscopic density of TiO is $d_{25} = 4.917 \pm 0.001$ g/cm³; the actual number of molecules per unit cell is $n' = 3.38$ indicating that there are 15.5% vacant sites in the lattice. With increasing titanium content an increase of the lattice constant, the macroscopic density, and the total number of vacant sites is observed. It is possible to regard the titanium-oxygen alloys as solid solutions of Ti₂O₃ in titanium. (auth)

25994

THERMODYNAMIC PROPERTIES OF MANGANESE-VANADIUM ALLOYS. A. M. Evseev and G. V. Pozharskaya (Moscow State Univ.). *Zhur. Neorg. Khim.* 5, 1896-7(1960) Aug. (In Russian)

Thermodynamic properties of Mn-V alloys were studied and the constitution diagram was plotted at 930 to 1100°C. The integral heat of formation, entropy, and free energy at 1238°K were found and partial and integral thermodynamic functions at $T = 1283^\circ\text{K}$ are tabulated. (R.V.J.)

25995

CONSTITUTION DIAGRAM OF TANTALUM-RHENIUM ALLOYS. M. A. Tylkina, I. A. Tsyanova, and E. M. Savitskiĭ (Baikov Inst. of Metallurgy, Academy of Sciences, USSR). *Zhur. Neorg. Khim.* 5, 1905-7(1960) Aug. (In Russian)

A constitution diagram was plotted for tantalum-rhenium alloys, and studies were made of the melting point, hardness microstructure, and x-ray diffraction of alloys prepared with 99.9% pure tantalum foils and 99.8% pure rhenium powder sintered at 1600°C in vacuum. The phase analysis was made with alloys annealed at 2000°C for 5 hr in a vacuum of 10^{-3} mm and at 1000°C for 560 hr, followed by tempering in water. The melting temperature of the solid solutions drops from 2996°C for pure tantalum to 2400°C for alloys containing 43.4 to 49% rhenium. Tantalum diffusion in rhenium is less than 5%. (R.V.J.)

25996

CONSTITUTION DIAGRAM OF VANADIUM-RHENIUM. M. A. Tylkina, K. B. Povarova, and E. M. Savitskiĭ (Baikov Inst. of Metallurgy, Academy of Sciences, USSR). *Zhur. Neorg. Khim.* 5, 1907-10(1960) Aug. (In Russian)

Physico-chemical analysis was made of vanadium-rhenium alloy and a constitution diagram of the peritectic type with two peritectics was plotted using 99.8% pure rhenium powder and 99.8% pure vanadium. The phase analysis was made on cast alloys annealed at 1750°C for 7 hr, 1600°C for 6 hr, and 1450°C for 5 hr in a vacuum at 10^{-4} mm mercury and at 1000°C for 450 hr and tempered in water. The measurements of hardness and microhardness are tabulated. The melting point of solid solutions rises from 1830°C for pure vanadium up to 2290°C for 32 to 43 at. % rhenium alloys. (R.V.J.)

25997

DETERMINATION OF THE ADHERENCE OF NICKEL

COATINGS ON ALUMINUM AND ITS ALLOYS. N. P.

Fedot'ev and A. M. Yampol'skiĭ. *Zhur. Priklad. Khim.* 33, 1844-9(1960) Aug. (In Russian)

The adherence of the galvanic coatings, which previously was estimated only in a qualitative manner, was measured more precisely by determining the force necessary to pull away the coating from the base metal under controlled conditions. The method made it possible to follow the change of adherence as a function of various experimental parameters, such as the variation of the concentration and the temperature of the plating solution, soaking time, additives used, etc. Although developed for nickel coatings on aluminum alloys, the methods may be used for determining adherence of metal coatings in general. (TTT)

25998

SILICON CARBIDE, A HIGH TEMPERATURE SEMICONDUCTOR. Proceedings of the Conference on Silicon Carbide, Boston, Massachusetts, April 2-3, 1959. J. R. O'Connor and J. Smiltens, eds. New York, Pergamon Press, 1960. 538p. \$12.50.

Forty-six papers are included on such topics as the silicon-carbon binary system, the growth of silicon carbide crystals, silicon carbide as a solid and as a semiconductor, and silicon carbide devices. The present state of knowledge of SiC is reviewed, and its uses as rectifiers transistors, electroluminescent source, thermoelectric generator, etc., are evaluated. The SiC phase diagram and details of crystal growth, physical properties, semiconductor properties, and applications are given. (W.D.M.)

25999

TERNARY ALLOYS OF URANIUM, COLUMBIUM, AND ZIRCONIUM. F. G. Foote (to U. S. Atomic Energy Commission). U. S. Patent 2,947,621. Aug. 2, 1960.

Ternary alloys of uranium are described which are useful as neutron-reflecting materials in a fast neutron reactor. They are especially resistant to corrosion caused by oxidative processes of gaseous or aqueous origin and comprise uranium as the predominant metal with zirconium and niobium wherein the total content of the minor alloying elements is between 2 and 8% by weight.

26000

METHOD OF SUPPRESSING UAl₄ FORMATION IN U-Al ALLOYS. M. L. Picklesimer and W. C. Thurber (to U. S. Atomic Energy Commission). U. S. Patent 2,950,188. Aug. 23, 1960.

A method is given for suppressing the formation of UAl₄ in uranium-aluminum alloys, thereby rendering these alloys more easily workable. The method comprises incorporating in the base alloy a Group Four element selected from the group consisting of Si, Ti, Ge, Zr, and Sn, the addition preferably being within the range of 0.5 to 20 at. %.

26001

PLUTONIUM-ZIRCONIUM ALLOYS. F. W. Schonfeld and J. T. Waber (to U. S. Atomic Energy Commission). U. S. Patent 2,950,967. Aug. 30, 1960.

A series of nuclear reactor fuel alloys consisting of from about 5 to about 50 at. % zirconium (or higher zirconium alloys such as Zircaloy), balance plutonium, and having the structural composition of a plutonium are described. Zirconium is a satisfactory diluent because it alloys readily with plutonium and has desirable nuclear properties. Additional advantages are corrosion resistance, excellent fabrication properties, an isotropic structure, and initial softness.

Radiation Effects

26002 AD-234120

Admiral Corp., Chicago.

EVALUATION AND DEVELOPMENT OF MIL-C-14157 CAPACITORS FOR NUCLEAR RADIATION ENVIRONMENT. Scientific Report No. 2. E. R. Pfaff. Jan. 1960. 32p. Contract Nobsr-77612.

Research directed toward development of a 0.1 μ f capacitor which will withstand Co^{60} environments of 10^5 r/hr for 1000 hr is described. Capacitors impregnated with bis(phenoxyphenyl)ether and others impregnated with mono-isopropylbiphenyl have low insulation resistance and capacitance. Several different dielectric tissues are being evaluated. (J.R.D.)

26003 AERE-R-3208

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE EFFECTS OF IONISING RADIATION ON SYNTHETIC AND NATURAL POLYMERS (PLASTICS, ELASTOMERS AND RESINS). R. F. Cox. July 1960. 17p. BIS.

Engineering information and data are presented on the effects of radiation on many polymers of great importance and current use in the engineering field which may have applications in nuclear installations. The information is necessarily brief and is offered as a guide to the general behavior of various plastics, elastomers, and resins when subjected to nuclear radiation. The information has been culled from a variety of sources, some of which were not written from an engineering viewpoint. No originality, except in the manner of presentation, is claimed by the author. (auth)

26004 ANL-6102

Argonne National Lab., Ill.

A STUDY OF IRRADIATION EFFECTS IN TYPE "A" NICKEL AND TYPE 347 STAINLESS STEEL TENSILE SPECIMENS. Final Report of Program 6.10.2. S. H. Paine, W. F. Murphy, and D. W. Hackett. July 1960. 44p. Contract W-31-109-eng-38. OTS.

In a comparison of Ni and stainless steel subsize tensile specimens, it was found that property changes induced by irradiation to an estimated fast flux of 4×10^{20} nvt were qualitatively similar to those produced by cold working. No basis for direct correlation was found. Tensile properties, elongation, hardness, density, electrical resistivity, corrosion, and annealing results are presented. It was determined that irradiation left the nickel and stainless steel specimens more ductile than did cold working to a comparable ultimate strength. Radiation hardening was found to be completely removed by a 1-hr anneal at 500°C, whereas temperatures of 600 to 800°C were required to anneal cold-work hardening. (auth)

26005 ANL-6180

Argonne National Lab., Ill.

IRRADIATION OF AN ALUMINUM ALLOY-CLAD, ALUMINUM-URANIUM ALLOY-FUELED PLATE. A. P. Gavin and C. C. Crothers. July 1960. 46p. Contract W-31-109-eng-38. OTS.

Irradiation tests of an aluminum-alloy-clad aluminum-uranium alloy-fueled plate were discontinued due to cladding failure after a maximum burnup of 58%. Cause of the failure was local corrosion of the aluminum alloy. Swelling was observed which was attributed to the combination of high burnup and high fuel temperatures. (C.J.G.)

26006 BMI-1466

Battelle Memorial Inst., Columbus, Ohio.

MEASURING THE RELEASE OF SHORT-LIVED FISSION GASES DURING CAPSULE IRRADIATIONS. Charles W. Townley, Gilbert E. Raines, Ward S. Diethorn, and Duane N. Sunderman. Sept. 12, 1960. 12p. Contract W-7405-eng-92. OTS.

A technique is described for the determination of the release of short-lived fission gases during capsule fuel irradiations. Sweep helium passes over the fuel specimen and carries fission gases to a delay trap located close to the capsule. Short-lived fission gases decay in the trap and deposit long-lived daughters which are assayed by radiochemical methods after trap removal. In two demonstrations of the technique the radiochemical analyses have provided information on the rate of release of 1.7-sec Xe^{141} , 16-sec Xe^{140} , 3.9 min Xe^{137} , and 3.2-min Kr^{88} . The technique should find considerable application in the irradiation evaluation of fuel materials when it is necessary to determine the contribution short-lived fission gases make to the coolant-contamination problem. (auth)

26007 CF-58-2-71

Oak Ridge National Lab., Tenn.

SUMMARY OF UO_2 -STAINLESS STEEL DISPERSION ELEMENT IRRADIATION EXPERIMENTS. V. O. Haynes, F. H. Neill, and L. D. Schaffer. Mar. 18, 1958. Decl. Sept. 14, 1959. 14p. Contract W-7405-eng-26. OTS.

A search of the literature to obtain information concerning enriched UO_2 -stainless-steel dispersion type fuel elements has disclosed five programs which have pertinent information. The primary aim of the search was to discover maximum burn-ups and temperatures for safe use of this type of element. Tests were labeled a failure if swelling, cracking or fission-product release resulted from the irradiation. Moderate swelling or blisters without the other indications was called a slight failure since further irradiation or higher temperature would undoubtedly cause complete failure. (auth)

26008 NAA-SR-5377

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

THERMALLY ACTIVATED POINT DEFECT MIGRATION IN COPPER. C. J. Meechan, A. Sosin, and J. A. Brinkman. Oct. 1, 1960. 30p. Contract AT-11-1-GEN-8. OTS.

A recovery model is presented which includes specific assignments of point-defect migration to the various recovery stages in copper. New experimental results showing the effects of prior cold work on the production and subsequent recovery of damage produced in copper by 10°K and 90°K electron irradiations are also presented. Irradiation recovery Stages I_D and I_E are suppressed by previous cold work. This suppression is reflected in an increased damage rate at 90°K, and the additional damage which remains in Stages I_D and I_E , or which is produced at 90°K, recovery in Stage III. The recovery in Stage III is altered from the bimolecular process characteristic of annealed copper. However, under certain conditions, a superrecovery occurs in Stage III, so that the measured resistivity drops below the preirradiation value. These observations are interpreted according to this recovery model. (auth)

26009 NP-9212

Alabama. Univ., Tuscaloosa.

SPECTROSCOPIC STUDIES OF IRRADIATION DAMAGED SOLIDS. Final Technical Report [for] September 1, 1959-

August 31, 1960. William G. Moulton. 1960. 22p. Contract DA-01-009-ORD-561.

On the basis of electron-spin-resonance spectra of a single crystal of KClO_3 after being exposed to x irradiation, a model is proposed for the V centers produced. The line widths and second moments of Cl^{35} pure quadrupole lines were measured as functions of x-irradiation time and inhomogeneous compression in sodium chlorate, potassium chlorate, and p-dichlorobenzene. Optical, electron paramagnetic resonance, and diffusion measurements were carried out on x-irradiated Lexan, a polycarbonate. Proton resonance in a single crystal of glycine is being studied. Work is in progress to determine the hydrogen bond lengths in the glycine, and to make careful measurements of the potential barrier against rotation or tunneling of the NH_3^+ group. Paramagnetic resonance studies were made of the impurity centers produced in Rochelle salt single crystals by x rays. (M.C.G.)

26010 TID-6504

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

REVIEW OF HANFORD RADIATION DAMAGE STUDIES ON GRAPHITE. R. E. Nightingale. Mar. 1, 1959. 5p. Contract W-31-109-Eng-52. OTS.

An outline of the Hanford program for radiation-damage studies on graphite is presented. Studies in the program consist of radiation-damage and annealing mechanisms, dimensional change, crystal-structure changes, stored energy, and gas-graphite reactions. (C.J.G.)

26011 WAPD-228

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

MEASUREMENT OF THE THERMAL CONDUCTIVITY OF METAL-CLAD URANIUM OXIDE RODS DURING IRRADIATION. I. Cohen, B. Lustman, and J. D. Eichenberg. Aug. 1960. 52p. Contract AT-11-1-GEN-14. OTS.

One of the uncertainties involved in the utilization of cold-pressed and sintered UO_2 for reactor fuel elements was the lack of adequate data concerning those factors affecting the thermal performance of oxide fuel elements. A series of in-pile experiments was completed which were designed to measure the "effective" thermal conductivity of UO_2 as a function of the diametral clearance between fuel and cladding, the gap-filling gas atmosphere, and the central temperature of the fuel. The experiments indicate a marked sensitivity of fuel-element thermal conductivity to initial assembly clearance as a result of the thermal-resistance barrier of the fuel-clad gap. (auth)

26012

IMPROVING THE STABILITY TIME OF LOW PRESSURE POLYETHYLENE PIPES BY IRRADIATION. H. Wilski and E. Gaube (Farbwerke Hoechst A.G., Frankfurt am Main). *Chem.-Ingr.-Tech.* **32**, 611-13(1960) Sept. (In German)

The stability times for low-pressure polyethylene pipes having an average value of 100 hr at 80°C and a comparison stress of 40 kg/cm^2 were improved by irradiation to about 10,000 hr. The pipes, however, cannot at present be used as hot-water pipes because of the high cost of irradiation and some unexplained stabilization questions. (auth)

26013

IRRADIATION EFFECTS AND SHORT-RANGE ORDER IN FUSED SILICA AND QUARTZ. R. A. Weeks and C. M. Nelson (Oak Ridge National Lab., Tenn.). *J. Appl. Phys.* **31**, 1555-8(1960) Sept.

The eigenvalues of the g tensor of an irradiation pro-

duced defect of the quartz structure were found to be $g_1 = 2.0003$, $g_2 = 2.0006$, and $g_3 = 2.0018$. The data on the center were consistent with the assignment of $S = \frac{1}{2}$. Assuming that the hyperfine interaction with Si^{29} ($I = \frac{1}{2}$ and 4.7% abundant) was negligible, the envelope of the line was calculated for 4 widths of the line. Good agreement was found between the calculated envelope for a width of 0.2 oe and the envelope observed in γ - and neutron-irradiated ($\leq 10^{18}$ fast neutrons/ cm^2) silica. The observed envelope deviated from the calculated envelope for increasing neutron irradiation. It is suggested that a correlation of the Si-O tetrahedra, similar to α -quartz, exists around any point in the more common forms of silicas and has a diameter of $\geq 5 \text{ \AA}$. (auth)

26014

MECHANISM FOR THE PRODUCTION OF F CENTERS IN NaCl BY IRRADIATION WITH GAMMA RAYS. J. H. Crawford, Jr. and F. W. Young, Jr. (Oak Ridge National Lab., Tenn.). *J. Appl. Phys.* **31**, 1688-9(1960) Sept.

A crystal of NaCl was cleaved into thin plates and etched to locate the dislocations. Pairs of these plates were then irradiated with γ rays. One of the plates was used to measure the optical density for computing F-center concentration, and the other plate was re-etched to relocate the position of the dislocations. Photomicrographs of the etch pits on the same area before and after irradiation are shown. None of the dislocations showed a measurable amount of climb. It appeared that if any F centers were produced by evaporation of the vacancies from the dislocations, they were not a significant fraction of the total. (M.C.G.)

26015

DRIFT MOBILITY IN NEUTRON IRRADIATED n-TYPE GERMANIUM. W. H. Closser (Sandia Corp., Albuquerque, N. Mex.). *J. Appl. Phys.* **31**, 1693(1960) Sept.

Measurements of drift mobility in neutron irradiated n-type germanium indicated an initial increase for low values of flux prior to the decrease that normally occurs. This is explained by the assumption that in addition to the large void regions introduced by the neutrons, there were also point defects introduced outside the void regions which acted as scattering centers for the minority carriers. Results also indicated that another factor other than point defects influenced the drift mobility. (M.C.G.)

26016

THERMAL BLEACHING OF F-CENTERS OF GAMMA-IRRADIATED KCl AT LOW TEMPERATURES. Noriaki Itoh and Tokuo Suita (Osaka Univ.). *J. Phys. Soc. Japan* **15**, 1716-17(1960) Sept. (In English)

In order to investigate the nature and formation mechanism of color centers in KCl formed by γ irradiation at low temperatures, the thermal bleaching curve of F centers was measured. The irradiated specimens were warmed at a rate of about $1^\circ\text{C}/\text{min}$. Sharp decreases in F centers occurred at temperatures of 98, 116, 172, 250, and 278°K , in addition to a gradual decrease with increasing temperature. This decrease appeared to be due to the thermal decomposition of V centers since F centers are stable thermally in this temperature range. (M.C.G.)

26017

ON THE STABILITY OF IRRADIATED ROUND PLANE. Yu. I. Remnev (Moscow State Univ.). *Nauch. Doklady Vysshei Shkoly, Fiz.-Mat. Nauki* No. 3, 145-7(1959). (In Russian)

An analysis was made of radiation effects on the mechanical properties of a thin round isotropic plane secured along the contour in such a manner that it can not stretch in radial directions. The plane was irradiated by a neutron flux symmetric to the plane $Z = 0$. (R.V.J.)

26018

RADIATION EFFECTS IN CLADDING MATERIALS. R. S. Barnes (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Nuclear Power* 5, No. 53, 122-3(1960) Sept.

Radiation effects are generally due to the behavior of radioinduced point defects and foreign atoms, and they are discussed with reference to fast neutron bombardment of cladding materials. Point defects cluster to form loops similar to those produced by quenching, and their annealing temperatures are the same. The mechanical properties are markedly altered by large numbers of loops ($\sim 10^{16}/\text{cm}^3$), especially internal friction which is reduced. Deformation is localized, and this can limit the use of cladding materials. However, if the cladding material is irradiated at a temperature above the annealing temperature, the loops do not form and these effects do not occur. This is the situation in which many cladding materials are used. Foreign atoms may be formed in cladding materials either by direct capture of neutrons or by impregnation with fission products. Xenon, krypton, and helium precipitate as bubbles at high temperatures, which grow by acquiring vacancies and may nucleate on dislocation lines. Since these bubbles lock the dislocations, they harden the material. Further heating coarsens the bubbles, thereby diminishing their hardening effect, but the bubbles increase in volume. This volume increase is accentuated by moving grain boundaries; therefore in material containing gas grain growth must be avoided. (D.L.C.)

26019

DEFECT INTERACTIONS IN IRRADIATED CALCIUM-DOPED POTASSIUM CHLORIDE. J. H. Crawford, Jr. and C. M. Nelson (Oak Ridge National Lab., Tenn.). *Phys. Rev. Letters* 5, 314-15(1960) Oct. 1.

The marked enhancement of the rate of formation of F centers in alkali halides containing alkaline earth impurities is well recognized. A mechanism is described which employs the isolated cation vacancy and satisfies the experimental requirements of small energy absorption and small volume change per F center. A description is given of the decomposition products of the center. Results from optical density measurements suggest that the proposed mechanism for the enhancement of F-center production in alkali halides is reasonable. The primary step is hole capture at a cation vacancy. The subsequent rearrangement creates an anion vacancy and a halogen atom in the cation site. Illustrations are included which show photon energies as a function of optical density and the change in optical density. (B.O.G.)

26020

EFFECTS OF γ -RAY AND NEUTRON IRRADIATION ON COMPOSITION RESISTORS AND HIGH MEGOHM RESISTORS. Tatuo Nakai and Takeshi Sakakibara. *Sci. Papers Inst. Phys. Chem. Research (Tokyo)* 54, 170-6(1960) June. (In English)

Two kinds of composition resistors (solid type and filament type) together with high megohm resistors were exposed to γ rays from Co^{60} and neutrons. The solid-type composition resistors suffered various kinds of characteristic changes in resistance; the filament-type resistors are fairly radiation-proof as the resistance of high megohm resistors decrease markedly and present an important problem for practical use. These phenomena are explained mainly by the difference of the synthetic resin binder and the distribution of carbon granules in the resistance element. (auth)

26021

ON THE COLOR DEPTH IN ALKALI HALIDE CRYSTALS

SUBJECTED TO BOMBARDMENT UNDER DIFFERENT ANGLES BY ELECTRONS WITH ENERGIES FROM 6 TO 15 kv. A. R. Shulman and É. P. Gel' (Kalinin Polytechnic Inst., Leningrad). *Soviet Phys-Solid State* 2, 489-94(1960) Sept.

Measurements were made of the color depth and its dependence on primary electron energy in monocrystals of KCl, KBr, NaF, and NaCl after bombardment from different angles by electrons with energies from 6 to 15 kev. The color depth was plotted as a function of electron energy. It was found that the depth increased when electron energy increased. In order to evaluate the degree to which the color depth is connected with the depth of electron penetration into the crystal, previously obtained data for other materials were compared with the values obtained for the alkali halides. The dependence of color depth on primary electron incidence angles was determined in NaF and NaCl for electron energies of 15 kev. (M.C.G.)

26022

IMPROVEMENTS IN OR RELATING TO THE OPERATION OF MACHINERY WHICH IS EXPOSED TO ATOMIC RADIATION. (to Socony Mobil Oil Co., Inc.). British Patent 846,798. Aug. 31, 1960.

Petroleum hydrocarbon lubricants can be protected against radioinduced increases of viscosity by incorporation of an oil-soluble organic cadmium, lead, or iron salt. Such a salt may be a salt of a fatty acid containing at least 12 carbon atoms, but the best salt for viscosity protection is a cadmium dithiocarbamate with two or more N-alkyl groups having 3 to 20 carbon atoms each. The concentration of the salt in the lubricant is generally between 1 and 4 wt. %. Typical light turbine oils without a salt, with cadmium diamyldithiocarbamate, with iron naphthenate, and with lead naphthenate were irradiated at doses up to 275 megarads and their kinematic viscosities (KV) compared at 100 and 210°F; the data for 100°F are plotted on a % increase in KV vs. megarads graph. For a 210-megarad exposure, the oil without a salt gave 16% increase in KV (100°F); whereas, the oil with cadmium diamyldithiocarbamate gave >3% increase. (D.L.C.)

26023

PROCESS FOR COLORING DIAMONDS. R. A. Dugdale (to U. S. Atomic Energy Commission). U. S. Patent 2,945,793. July 19, 1960.

A process is given for coloring substantially colorless diamonds in the blue to blue-green range and comprises the steps of irradiating the colorless diamonds with electrons having an energy within the range 0.5 to 2 Mev to obtain an integrated electron flux of between 1 and 2×10^{18} electrons/cm². With electrons having an energy of 1 Mev the diamonds may be irradiated 1 hr when they take on a blue color with a slight green tint. After being heated at about 500°C for half an hour they become pure blue. Electrons within this energy range contain sufficient energy to displace the diamond atoms from their normal lattice sites to interstitial sites, thereby causing the color changes.

PHYSICS**General and Miscellaneous****26024** A/AC.82/G/L.391

Gakushuin Univ., Tokyo.
RECENT VARIATION IN THE ATMOSPHERIC RADIOCARBON AND THE PROBLEM OF TRANSFER OF RADIOCARBON INTO HYDROSPHERE. Kunihiro Kigoshi. May 1960. 13p.

Results are given of measurements of atmospheric radiocarbon using tree rings of the Japanese cedar for which the growth and date of cut were known. The results show a 24% increase in 1959, which is in good agreement with samples taken in California. Assuming a residence time of 7 years and a mixing layer of 75 m, the increase of C^{14} in the sea surface based on C^{14} in the atmosphere is calculated to be 4.7% in Jan. 1960. (T.R.H.)

26025 AD-234160

Cornell Univ., Ithaca, N. Y.

SATURATION AND DOUBLE-FREQUENCY IRRADIATION STUDIES OF THE TWO-PROTON SYSTEM IN $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$. Technical Report No. 4. D. F. Holcomb and T. R. Sliker.

Dec. 29, 1959. 30p. Contract N-onr-401(15). OTS.

A number of experiments were performed on the proton spin system in $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ with r-f power level sufficient to appreciably saturate the nuclear spin resonance. The general purpose of the experiments was to observe effects of the strong r-f excitation on the interproton magnetic dipolar interactions. The experiments are interpreted in the framework of a three-energy-level system determined by the dominant magnetic interaction, that between the two protons in a water molecule in the crystal. Observations were made of the dispersion and absorption modes in a standard CW experiment. In a second set of experiments, two radio-frequency oscillators were employed. One oscillator, operating at large r-f magnetic-field strengths, produced a large absorption at one frequency while the other, low-level oscillator was used to sample the absorption line shape in the presence of the large field strengths by sweeping the frequency of the low-level oscillator. Using crossed coils, the oscillators could be operated with their frequencies differing by as little as 5 kc, at 12 mc, without interacting strongly. In these experiments, small changes in line shape and an enhancement of the absorption signal from one line while saturating the other were observed. The presence of this enhancement demonstrates the existence of multiple spin flip relaxation processes. (auth)

26026 AERE-R-3300

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

PHOTOGRAPHIC EMULSION DOSIMETRY AND THE A.E.R.E. FILM DOSIMETER. M. J. Heard, J. E. Cook, and P. D. Holt. June 1960. 48p. BIS.

The mechanisms underlying the photographic action of ionizing radiation are reviewed, and the application to dosimetry is discussed. The properties of Ilford P M 1 film and of the AERE film holder are described. The film has a peak sensitivity at 40 kev about 20 times that for radium gamma radiation. The film plus holder, or dosimeter, has a variation in sensitivity of a factor of 2 over the energy range 70 kev to 3 Mev, and a variation of $\pm 20\%$ over the energy range 150 kev to 1.5 Mev. In this energy range the dose range which can be measured is 0.02 to 20 rads. Errors arising in processing and densitometry are estimated. Appendices give details of the experimental measurement of gamma energy dependence, orientation effects and slow-neutron sensitivity. (auth)

26027 AFOSR-TR-60-112

Rocketdyne Div., North American Aviation, Inc., Canoga Park, Calif.

FINAL REPORT FOR EXPERIMENTAL ELECTRICAL PROPULSION STUDY FOR THE PERIOD MAY 1, 1958 THROUGH MAY 31, 1960. C. R. Dulgeroff and G. D. Seele. July 1960. 74p. Project No. 9752. Contract AF49(638)-351. (R-2565).

Investigation of ion thrust chamber geometry, using both accelerate-decelerate electrode geometry and modified Pierce two-electrode geometry designs, proved the latter superior in its focusing properties. Current densities to 12 ma/cm² for tungsten, tantalum, or titanium carbide ionizers were measured with a calorimetric collector.

Thrust, to 50 micropounds, was measured with a pendulum type collector. A sputtering rate of 22 g/amp-hr for 9-kev cesium ions on nickel, and an ionization efficiency of 90% over a 30-hr period were observed. Compatibility tests of several metals with cesium showed that 100-hr reaction times at 1000°C adversely affect nickel and 321 stainless steel. (auth)

26028 ANL-6184

Argonne National Lab., Ill.

TABLE OF ASYMMETRIC ROTOR E2 TRANSITION PROBABILITIES. Paul P. Day and Carlos Alberto Mallmann. Aug. 1960. 56p. Contract W-31-109-eng-38. OTS.

Tables of gamma-ray transition probabilities predicted by the asymmetric rotor model of even-even nuclei were calculated. Tables are also presented on the coefficients of the rotational wave functions as a function of k, the asymmetry parameter. A third table gives the values of parameters needed to calculate energy levels in the hydrodynamical model using molecular spectroscopy tables. (C.J.G.)

26029 CERN-60-30

European Organization for Nuclear Research. Geneva.

APPLICATION OF A GENERALIZED METHOD OF LEAST SQUARES FOR KINEMATICAL ANALYSIS OF RACKS IN BUBBLE CHAMBERS. R. Böck. Aug. 15, 1960. 13p.

An application of the least-squares method to the analysis of bubble-chamber photographs, particularly to the fitting of geometrically reconstructed chamber tracks to the law of momentum and energy conservation at an interaction vertex, is described. (C.J.G.)

26030 CU(PNPL)-203

Columbia Univ., New York. Pegram Nuclear Physics Labs.

PROGRESS REPORT FOR JANUARY, FEBRUARY, MARCH 1960 TO THE UNITED STATES ATOMIC ENERGY COMMISSION. 47p. Contract AT-30-1-GEN-72. OTS.

Sixty-one resonances in I^{127} were analyzed up to an energy of 815 ev. In addition to the neutron width, 18 values of radiation width were obtained. The new proton beam deflection circuitry was successfully tested. A fast neutron scintillation counter, which employs pulse-shape analysis for gamma rejection, is being tested. The associated circuitry, having a gamma lead time of 0.4 to 0.5 μsec , was developed. Measurements with the neutron spectrometer are described. Internal conversion electrons from the second excited state of Ca^{42} were observed in a magnetic spectrometer by proton inelastic scattering. Studies of $\text{F}^{19}(\text{He}^3, \text{d})$ and $\text{Li}^7(\text{He}^3, \text{d})$ at 3.5 Mev showed that no new states appeared in Be^8 in the energy gap of excitation 3 to 12 Mev, and that the intensity distribution of the d-spectrum from $\text{Fe}^{59}(\text{He}^3, \text{d})$ is quite different from that of the n-spectrum leading to the same states in the $\text{Fe}^{59}(\text{d}, \text{n})$ reaction. The charge exchange reaction using (He^3, T) on mirror nuclei Be^9 and Li^7 was investigated. A beam pipe assembly that consists of a strong focusing electrostatic lens, diffusion pump, and gas target was constructed and tested. The lifetime of the first excited state of Hg^{198} was measured using the double coincidence beta spectrometer. The anisotropy of the angular correlation between the 0.3 and 1.5 Mev γ -rays of Ca^{42} was investigated. A variable speed turntable assembly for preliminary Mössbauer effect

studies was designed and constructed. A positioning unit for controlling the azimuth of a detector in a γ - γ angular correlation arrangement was designed. Development of a low-noise preamplifier is discussed. The ten-channel time-of-flight analyzer was completed after several modifications. A fast coincidence circuit was constructed and tested. (For preceding period see CU(PNPL-202.) (W.D.M.)

26031 HW-65308

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

STUDIES IN MICROMERITICS. I. PARTICLE DEPOSITION IN CONDUITS AS A SOURCE OF ERROR IN AEROSOL SAMPLING. A. K. Postma and L. C. Schwendiman. May 12, 1960. 24p. Contract AT(45-1)-1350. OTS.

The principal mechanisms by which particles moving in a conduit reach the wall are gravitational settling, thermal forces, Brownian movement, electrical forces, and turbulent diffusion. Empirical and theoretical expressions and graphs are presented from which the importance of each mechanism as a function of conduit diameter, flow rate, and particle size can be estimated. Gravitational settling and turbulent deposition were found to be of greatest importance, especially when particles larger than 1μ are to be sampled. (auth)

26032 LA-2432

Los Alamos Scientific Lab., N. Mex.

REVISED NEUTRON FLUX, SPECTRUM, AND TISSUE DOSE MEASUREMENTS AT THE GODIVA II CRITICAL ASSEMBLY. Joseph A. Sayeg. Apr. 1960. 24p. Contract W-7405-eng-36. OTS.

Addendum to LA-2310.

Neutron-flux, spectra, and tissue-dose measurements were made at the Godiva II critical assembly by foil activation techniques. (C.J.G.)

26033 LMSD-703052

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

DISTRIBUTION FUNCTION OF MAGNETICALLY CONFINED ELECTRONS IN A SCATTERING ATMOSPHERE. W. M. MacDonald and M. Walt. Sept. 1960. 30p. Contract Nonr-1797(00). OTS.

A system of electrons confined in an inhomogeneous magnetic field in the presence of a nonuniform atmosphere of scattering particles is described at any instant by the distribution function appropriate to the situation in which no atmosphere is present. A generalization of the Fokker-Planck equation is then derived for the evolution in time of the distribution function through these quasi-equilibrium distributions. An approximate solution of this equation is given for the case of electrons trapped in the earth's magnetic field. This solution yields the distribution of the electrons in energy and angle as a function of time. (auth)

26034 MND-P-2375

Thompson Ramo Wooldridge Inc. New Devices Labs., Cleveland.

SNAP I POWER CONVERSION SYSTEM DEVELOPMENT. Period covered: February 1, 1957 to June 30, 1959. R. C. Biering, D. D. Carrell, P. E. Grevstad, N. P. Otto, J. W. Picking, G. M. Thur, and R. F. Wulf. June 20, 1960. 68p. For Martin Co. Contract AT(30-3)-217. (ER-4050). OTS.

Development of the SNAP I power conversion system is described. The system is designed to convert the thermal energy produced by the decay of radioisotopes into 500 watts of electrical energy by means of a mercury Rankine cycle. A list of specific accomplishments of the program is included. (J.R.D.)

26035 MND-P-2376

Thompson Ramo Wooldridge Inc. New Devices Labs., Cleveland.

SNAP I POWER CONVERSION SYSTEM TURBINE DEVELOPMENT. Period covered: February 1, 1957 to June 30, 1959. D. C. Reemsnyder and E. M. Szanca. June 20, 1960. 54p. For Martin Co. Contract AT(30-3)-217. (ER-4051). OTS.

Turbine development for the SNAP I power conversion system is described. A three-stage axial flow turbine with the first two impulse stages partial admission and the last stage full admission with a slight amount of reaction was selected. Other design and performance data are included. (J.R.D.)

26036 MND-P-2377

Thompson Ramo Wooldridge Inc. New Devices Labs., Cleveland.

SNAP I POWER CONVERSION SYSTEM ALTERNATOR DEVELOPMENT. Period covered: February 1, 1957 to June 30, 1959. H. J. Morgan. June 20, 1960. 43p. For Martin Co. Contract AT(30-3)-217. (ER-4052). OTS.

Alternator development for the SNAP I power conversion system is described. A radial air-gap permanent-magnet 6-pole single-phase 2000-cps alternator, rated at 530 watts, 0.8 power factor, and 115 volts was selected. Discussion of requirements and specifications, design and performance, test facilities, and conclusions are included. (J.R.D.)

26037 MND-P-2378

Thompson Ramo Wooldridge Inc. New Devices Labs., Cleveland.

SNAP I POWER CONVERSION SYSTEM PUMP DEVELOPMENT. Period covered: February 1, 1957 to June 30, 1959. E. S. Kovalcik and D. C. Reemsnyder. June 20, 1960. 59p. For Martin Co. Contract AT(30-3)-217. (ER-4053). OTS.

Pump development for the SNAP I power conversion system is described. A four-vaned impeller pump supplemented by a jet boost stage was selected for development to meet the final design requirements. Information on other designs, pump test facilities, and conclusions are included. (J.R.D.)

26038 MND-P-2379

Thompson Ramo Wooldridge Inc. New Devices Labs., Cleveland.

SNAP I POWER CONVERSION SYSTEM BEARINGS DEVELOPMENT. Period covered: February 1, 1957 to June 30, 1959. R. Meredith, G. Y. Ono, and D. C. Reemsnyder. June 20, 1960. 68p. For Martin Co. Contract AT(30-3)-217. (ER-4054). OTS.

Development of bearings for use in the SNAP I power conversion system is described. Liquid mercury, lubricated hydrosphere bearings were selected. Design and performance data are given along with conclusions. (J.R.D.)

26039 MND-P-2380

Thompson Ramo Wooldridge Inc. New Devices Labs., Cleveland.

SNAP I POWER CONVERSION SYSTEM CONTROL DEVELOPMENT. Period covered: February 1, 1957 to June 30, 1959. W. E. Dauterman, M. W. Mueller, and E. J. Viton. June 20, 1960. 50p. For Martin Co. Contract AT(30-3)-217. (ER-4055). OTS.

Development of the control elements for the SNAP I power conversion system is described. A description of test and prototype hardware and performance data are included. The control package in its final design is a combination of regulator and speed-sensitive feedback which provides satisfactory steady-state operation and serves as a mechanism correction for system disturbances. (J.R.D.)

26040 MND-P-2381

Thompson Ramo Wooldridge Inc. New Devices Labs., Cleveland.

SNAP I POWER CONVERSION SYSTEM CONDENSER-RADIATOR DEVELOPMENT. Period covered: February 1, 1957 to April 15, 1959. R. J. Kiraly and D. C. Reemsnyder. June 20, 1960. 47p. For Martin Co. Contract AT(30-3)-217. (ER-4056). OTS.

Development of the condenser-radiator for use in the SNAP I power conversion system is described. Although no prototype hardware was designed or tested in the program, the concept of rejecting waste by radiation in a gravitationless environment was proved feasible. (J.R.D.)

26041 MND-P-2382

Thompson Ramo Wooldridge Inc. New Devices Labs., Cleveland.

SNAP I POWER CONVERSION SYSTEM MATERIALS DEVELOPMENT. Period covered: February 1, 1957 to June 30, 1959. V. F. Hambor and J. J. Owens. June 20, 1960. 38p. For Martin Co. Contract AT(30-3)-217. (ER-4057). OTS.

Investigations of materials for use in connection with the SNAP I mercury Rankine cycle power conversion system are discussed. Test programs are outlined and results are tabulated for each candidate material. Several nonmetallic materials and processing procedures were developed which enabled uncooled high-performance electric machinery to operate at 550°F in mercury vapor. (J.R.D.)

26042 NASA-TN-D-431

National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.

AN EXPERIMENTAL STUDY OF THE IONIZATION OF LOW-DENSITY GAS FLOWS BY INDUCED DISCHARGES. R. L. Barger, J. D. Brooks, and W. D. Beasley. Sept. 1960. 22p. OTS.

A 40-Mc oscillator was used to produce and maintain induced discharges in argon and mercury-vapor flows. Methods for preventing blowout of the discharge were determined, and power measurements were made with an in-line wattmeter. Results with damped oscillations pulsed at 1000 pulses per second are presented. (auth)

26043 NP-8972

California Inst. of Tech., Pasadena. Jet Propulsion Lab. ASTRONAUTICS INFORMATION; OPEN LITERATURE SURVEY, VOLUME II, NUMBER 6 (ENTRIES 21,871-22,113). June 1960. 59p. Contract NASw-6.

A survey of the open literature for June 1960 on astronautics information is presented. The material presented is organized alphabetically according to subject. Cumulative author and subject indexes are given. (W.D.M.)

26044 NP-8987

Massachusetts Inst. of Tech., Cambridge. Solid-State and Molecular Theory Group.

QUARTERLY PROGRESS REPORT NO. 37. July 15, 1960. 123p. Contract Nonr-1841(34).

Work on the hexagonal ring of six hydrogen atoms was completed. The 268 energy levels arising from all possible arrangements of the six electrons in the six 1s atomic orbitals were determined. This takes into account all possible ionic states and represents a complete configuration interaction treatment to the extent to which this is possible occupying only 1s orbitals. A study is presented on the atomic-scattering factors of neutral atoms in configurations $3d^{n-2}4s^2$ and the effect of various perturbations on the wave functions and scattering factors. These effects include the effect of an unbalanced magnetism, both on the isolated atom and the atom in a crystalline field and the effect on

an iron-group ion of a simple electrostatic approximation of the type of crystalline field found in inorganic compounds. An investigation is proposed of the interaction of various electrons in the MnO crystal. The work will be carried out essentially by methods of linear combination of atomic orbitals or the tight binding approximation. A preliminary study is reported on the method of handling crystals of the NaCl structure by the augmented-plane-wave method. Progress in the study of iron by this method is also reported. Work on automatic computer coding is summarized. (For preceding period see NP-8600.) (W.D.M.)

26045 NP-9116

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

ATMOSPHERIC OZONE: ITS DETECTION, MEASUREMENT AND EFFECTS, 1940 TO 1959. An Annotated Bibliography. A. A. Beltran, comp. July 1, 1960. 63p.

Literature on the detection, measurement, and effects of atmospheric ozone is covered from 1940 to 1959, with a few references to the literature of the 1930's. Arrangement is alphabetical by author for the 154 references. Abstracts are included. (W.D.M.)

26046 NP-9146

California. Univ., Berkeley. Materials Research Lab. HEAT CAPACITY OF LIQUID BISMUTH. Technical Report No. 1. Howard Bell and Ralph Hultgren. July 1, 1960. 18p. Contract Nonr-222(63).

The true heat capacity of liquid bismuth was measured from 544.5 to 801.8°K by a method of mixtures using a liquid bismuth calorimeter. The results show a decrease in heat capacity with increasing temperature. The results are discussed in relation to the structure of the liquid. One conclusion reached is that there are associations similar to those found in the solid in the vicinity of the melting point which break up with increasing temperature. (auth)

26047 NP-9155

Harvard Univ., Cambridge, Mass. Craft Lab.

TABLES FOR THE CALCULATION OF COULOMB WAVE FUNCTIONS. Technical Report No. 204. Frank S. Ham. Nov. 5, 1955. 88p. Contract N5ori-76.

Tables of the coefficients in the series expansions of Coulomb wave functions in powers of the energy $\epsilon = -1/n^2$ are given, and the theory of these expansions is reviewed and extended. It is shown that the series used to calculate the irregular Coulomb function diverges but represents this function asymptotically in the limit $|n| \rightarrow \infty$, $|\arg(n)| \geq \pi - \Delta < \pi$. A convergent series is derived which may be used to calculate this function to greater accuracy than is possible with the asymptotic series. The coefficients in the series for both the regular and irregular functions and their derivative with respect to the radial parameter z are tabulated for $L = 0$, $z = 3.5(0.1)7.5$. Coefficients in both the asymptotic and convergent series for the irregular function are given, together with tables of a function $G_0(0,n)$, needed in calculating the irregular function $(z/2) N_0^n(z)$ from the convergent irregular series. Tables of the coefficients for the regular function and its z -derivative for $L = 8$ are also given for the same range of z . Related tables of an appropriate power of $(z/2)$ times the series coefficients for both $L = 0$ and $L = 8$ are given which make possible interpolation in z . Recurrence relations are put in a form suitable for use in calculating the functions of $0 \leq L \leq 8$ from functions of $L = 0$ or 8 obtained from these tables. The present tables extend those given by T. S. Kuhn (Quarterly of Applied Math. 9, 1(1951)) and correct several errors in his tables. Both sets of tables make possible the

calculation of Coulomb functions for an attractive Coulomb potential only. (auth)

26048 NP-9165

Tokyo Univ. Inst. for Nuclear Study.

ANNUAL REPORT, JULY 1955-MARCH 1960. May 1, 1960. 71p.

The history and organization of the Institute for Nuclear Study are given. Research summaries and development progress are presented for the low-energy, high-energy, cosmic-ray theory, and chemistry divisions. A list of publications is included. (W.D.M.)

26049 NP-9187

Wisconsin. Univ., Madison.

USE OF THE FARADAY EFFECT IN DETECTING SMALL CHANGES IN THE EARTH'S MAGNETIC FIELD AND MEASUREMENTS OF THE FARADAY EFFECT IN GASES AND VAPORS. Final Report. L. R. Ingersoll and D. H. Liebenberg. [1959?] 36p. Contract Nonr-07100.

A photoelectric method of measuring magneto-optical rotations as small as $1''$ of arc was developed. Initially the apparatus was used to determine the small-magnitude short-period changes in the earth's local magnetic field to an accuracy of 1 part in 1440 of the horizontal component. Recently Verdet constants at 22 wavelengths throughout the spectral range 3695 to 9875 Å were measured for the following gases: He, Ne, Ar, Kr, Xe, N, O, H, D, nitric oxide, nitrous oxide, CO, CO₂, sulfur hexafluoride, Freon-12, sulfur dioxide, ammonia, methane, ethane, acetylene, propane, cyclopropane, ethylene, n-Butane, isobutane, water vapor, deuterium oxide, ethyl alcohols, methyl alcohol, chloroform, ether, carbon disulfide, and carbon tetrachloride. In addition the Verdet constants of the liquids were measured for the liquid of the last eight listed vapors. Pressure and temperature dependences were measured in the ranges 10 to 220 cm Hg and 20 to 50°C, respectively. Comparison is made with the results of other investigations where possible and a discussion of the results in terms of the current theory is presented for some of the simpler gases. (auth)

26050 NP-9190

Space Technology Labs., Inc. Physical Research Lab., Los Angeles.

EXTENDED HYPERVELOCITY GAS DYNAMIC CHARTS FOR EQUILIBRIUM AIR. Richard W. Ziemer. Apr. 14, 1960. 40p. Contract AF04(647)-309. (STL/TR-60-0000-09093).

The dynamic properties of gas, associated with a traveling normal shock, stationary normal shock, stagnation point, and reflected normal shock, were computed for incident shock velocities of up to Mach 50. The computation, one of successive approximations and utilizing graphical thermodynamic data, has an estimated accuracy of 1 to 10%, with the major portion correct to within 5%. The properties of density, pressure, temperature, internal energy, and enthalpy are plotted vs. shock velocity for initial densities of 10^{-1} to 10^{-5} times atmospheric density and an initial temperature of 273.2°K. A Mollier diagram and an enthalpy-density cross plot are included. (auth)

26051 NP-9202

American Machine and Foundry Co., Alexandria, Va.

ION AND ATOMIC BEAMS IN SPACE. Semi-Annual Report No. 2 [for] January 1 through June 30, 1960. Robert L. Carroll. July 20, 1960. 32p. Contract DA-36-039SC-78961.

The problems of ion-beam transmission for communication systems under outer space conditions are studied with considerations of the effects of fields and particles in

the solar system. It is concluded that beam divergence, owing to self-contained fields and thermal effects, is the limiting factor on the available distance of transmission, with other effects secondary. It is noted that the phenomena of beam transmission may be useful for power transfer, ion-propulsion systems, or weapons systems. (For preceding period see NP-8481.) (W.D.M.)

26052 NP-9219

Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research.

PROGRESS REPORT NO. 27. July 1960. 71p. Contracts Nonr-1841(10), Nonr-1841(50), AF19(604)-6155, AF19(604)-5482, and AF33(616)-5920.

Work in progress under headings characterizing the phenomena being investigated is summarized in some detail. Topics covered include formation and response of electric dipole systems, magnetic dipole systems, magnetic resonance, optical absorption and color centers, crystal formation, crystal-structure analysis, conduction and field emission, ions and electric dipoles, ultrasonic research, and instrumentation. (W.D.M.)

26053 NYO-2501

Radiation Applications Inc., New York.

THE TECHNOLOGY AND APPLICATIONS OF LARGE FISSION PRODUCT BETA SOURCES. Quarterly Report for Period Ending June 30, 1960. 20p. Contract AT(30-1)-2186. OTS.

Additions of lead oxide to strontium-containing enamels have not improved their acid resistance. A powder spreader was developed which allows the remote and automatic deposition of uniform and reproducible enamel coatings on source-backing materials. An extrapolation chamber was constructed, but surface dose-rate measurements with it were not successful for the very-low-activity beta sources on hand. It will be useful for dose-rate determinations with the higher-activity sources which are to be prepared. Pre-irradiation hot styrene or comonomer dips show an increase in the grafting rate for the methacrylic acid-styrene system on polypropylene. A strong temperature dependence is shown for MAA-styrene radiation graft copolymerization on polypropylene. Major polypropylene fiber producers have expressed interest in samples of grafted dyeable polypropylene fabric which were prepared at RAI. Work is continuing on a design and cost estimate for a pilot-scale graft-copolymerization beta irradiator. (auth)

26054 PR-P-45

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

PHYSICS DIVISION PROGRESS REPORT FOR JANUARY 1, 1960 TO MARCH 31, 1960. 89p. (AECL-1069). AECL.

Reactions of C¹² with C¹², O¹⁶ and C¹² with O¹⁶ were studied in the energy range from 6 to 35 Mev using beams of well-defined energy from the Tandem Accelerator. The use of semiconductor counters enabled careful measurements of the emission probability for the various particles to be made as a function of the bombarding energy and the emission angle. It was concluded from examination of world data that the sharp increase in neutron-counting rate observed at Deep River on July 17, 1959, was a sea-level effect of cosmic rays generated in a solar flare. Installation of equipment to make the energy of the monoenergetic beam of the crystal spectrometer at Hole C-5 of the NRU reactor continuously variable permitted a new type of experiment to be performed. The monoenergetic neutrons are scattered by the specimen into a B¹⁰F₃ proportional counter through a filter composed of 4 in. of

beryllium. The counter is therefore only sensitive to neutrons of wavelength longer than the beryllium cut-off, i.e., to neutrons with energy less than 5×10^{-3} ev. In operation the number of counts accumulated in the beryllium-shielded detector is recorded for a fixed number of counts from a thin fission counter located in the incoming beam of energy E . Since the mean energy of the scattered neutrons counted is approximately 3×10^{-3} ev, a peak in the recorded intensity as a function of E therefore corresponds to a lattice vibration with an energy ($E - 0.003$) ev. Preliminary measurements were made on water and on lithium hydride. It is hoped that the method will be of considerable use in studies of optical vibrations in hydrogenous substances. The magnetic-tape-recorder equipment is now in service in the Moderator Scattering Law experiment, and development of a fast means of read-out from the 900-channel sorter used in this experiment is nearing completion. A new 900-channel analyzer designed for coincidence experiments is being constructed, and effort is being specially directed toward producing an effective display for the 900 channels. A complete coincidence system is in operation using transistor double-delay line amplifiers and a fast-slow coincidence and amplitude selector unit. The amplifier performance is comparable with, or better than, all other existing double-delay line units. The noise in semiconductor junction detectors was investigated and found to be mainly due to the leakage current in the junction itself when a good low-noise amplifier is used. Consequently the optimum time constant in an amplifier is much shorter when using these detectors than when using ion chambers. Investigations into the low-noise-potential Nuvistor triodes were carried out. Results on early tubes were very promising, but recent tubes exhibit high grid current, probably due to emission of electrons from the grid. Work continued on a data-recording and display system for reactor experiments. Solid-state input switches, amplifiers, and analogue to digital converters were designed and a magnetic drum was ordered for storage of the data. A drum was chosen to provide rapid and continuous access to storage data for the display system. (For preceding period see PR-P-44.) (W.D.M.)

26055 TID-6326

Michigan. Univ., Ann Arbor. Coll. of Literature, Science, and the Arts.

QUANTUM CALCULATIONS OF THE VELOCITY DEPENDENCE OF THE DIFFERENTIAL AND TOTAL CROSS SECTIONS FOR ELASTIC SCATTERING OF MOLECULAR BEAMS. Richard B. Bernstein. Aug. 1960. 19p. Contract AT(11-1)-321. (UMRI-03043-2-T). OTS.

The partial wave treatment of the elastic scattering of molecular beams was applied to the calculation of the velocity dependence of the differential and total cross sections for an assumed Lennard-Jones (L.-J.) (12,6) potential. Most of the calculated ϵ, σ values were chosen to correspond to the H_2 -Hg system. The range of the velocity parameter $A \equiv k\sigma = \mu v\sigma/\hbar$ is from 3 to 30; this is equivalent to a 100-fold variation in H_2 beam temperature (i.e., 8.2 to 820°K). Computations of the angular distribution of the scattering ($d\sigma(\theta)/d\Omega$) and the total cross section (Q) as a function of A are reported. A correlation of the interference maxima in $d\sigma(\theta)/d\Omega$ is presented. The Massey-Mohr approximation for $Q(A)$ for an inverse sixth-power attractive potential is compared with the present calculations for the L.-J. (12,6) potential. Significant undulatory deviations are noted at low A ; this effect is attributed to the existence of the broad maximum in the phase shift curve $\eta(l)$, which, in turn, originates from the negative

repulsive phases at low l . Consideration is given to the question of the sensitivity of the scattering to the repulsive part of the potential. (auth)

26056 TID-6593

Illinois. Univ., Urbana.

HYPERFINE STRUCTURE OF THE F-CENTER IN LiF. W. C. Holton, H. Blum, and C. P. Slichter. 1960. 12p. Contract AT(11-1)-833. OTS.

The paramagnetic resonance of LiF crystals containing F and M centers was investigated. The observation of 35 lines in electron spin resonance (ESR) is reported. Electron-nuclear double resonance data were determined from which the observed ESR is predicted. (C.J.G.)

26057 UCRL-5665

California. Univ., Livermore. Lawrence Radiation Lab.

PROCEEDINGS OF THE SECOND SYMPOSIUM ON THE APPLICATION OF PULSED NEUTRON SOURCE TECHNIQUES, HELD AT THE LAWRENCE RADIATION LABORATORY, BERKELEY, CALIFORNIA, DECEMBER 4-5, 1958. 181p. Contract W-7405-eng-48. OTS.

The papers presented at the meeting were recorded and transcripts are given along with the discussion which followed each paper. Separate abstracts were prepared for 12 of the 13 papers presented. (W.D.M.)

26058 UCRL-9215

California. Univ., Berkeley. Lawrence Radiation Lab.

PHYSICS DIVISION SEMI-ANNUAL REPORT [FOR] NOVEMBER 1959-APRIL 1960. June 1960. 41p. Contract W-7405-eng-48. OTS.

Brief summaries are given of the research programs in general physics (liquid hydrogen bubble chambers, strange particles, nucleon interactions, meson scattering, etc.), accelerator development and operation and development, and health physics. (For preceding period see UCRL-9017.) (W.D.M.)

26059 USCEC-56-212

University of Southern California, Los Angeles. Engineering Center.

INTERACTIONS OF RAPIDLY MOVING BODIES IN TERRESTRIAL ATMOSPHERE. K. P. Chopra. Mar. 31, 1960. 153p. Contract AF18(603)-95. (AFOSR-TN-60-398).

The drag of a moving body or satellite in the upper atmosphere where the molecular mean free paths are large is studied with special reference to interactions with magnetic fields. The various models for aerodynamic drag are reviewed, and some theoretical expectations for cone and cylindrical satellites (Sputnik III and Explorer IV) are tabulated, tumbling effects included. Gyration of charged particles in a magnetic field is studied; at the altitudes of interest, electrons but not ions are free to spiral. Satellites will become charged because of their contact with charged particles; they usually become negatively charged and, since their velocity is greater than that of ions, they behave like enormous ions with large charges. There is also drag due to Coulomb interaction of the satellite with charged particles, which describe hyperbolic orbits around the satellite. Present theories of Coulomb drag are critically reviewed. According to the Chopra-Singer theory, Coulomb drag contributes significantly to the total drag at 350 km, becomes comparable to the neutral drag at 500 km, and is predominant above 650 km. The next kind of drag considered is induction drag, caused by electric currents induced by the motion through the magnetic field. Induction drag tends to damp out rotational as well as translational motion and is negligible compared to neutral drag at 250 km but becomes large at 500 km. A sphere in strong magnetic fields does not affect the magnetic fields

if the Reynolds number of flow is large and the magnetic Reynolds number is small, and a cylinder of fluid with radius equal to that of the sphere is pushed out in front of the sphere. Large magnetic Reynolds numbers are also considered. Another kind of drag is that caused by generation of electromagnetic waves from the satellite; they propagate along the direction of the magnetic field at a velocity slightly less than that of the satellite. The contribution of this drag is negligible at 250 km but is comparable to the Coulomb drag at 800 km. Experimental apparatus for the simulation of electron and ion bombardment and aerodynamical testing of a satellite are described. A bibliography of 103 references is given. (D.L.C.)

26060 USNRDL-TR-439

Naval Radiological Defense Lab., San Francisco.

TRANSMISSION AND SCATTERING PROPERTIES OF A NEVADA DESERT ATMOSPHERE. M. G. Gibbons, J. R. Nichols, F. I. Laughridge, and R. I. Rudkin. Dec. 11, 1959. 40p. (DASA-1163).

The angular scattering diagram of a Nevada desert atmosphere was measured for radiation of 0.40, 0.45, 0.50, and 0.55 μ wavelength, and attenuation coefficients for scattering and absorption were determined in the same atmosphere for radiation of 0.40, 0.50, 0.70, and 0.83 μ wavelength. The ratio of scattered-in to direct radiation received from a $4-\pi$ source was measured for receiver fields of view ranging from 4 to 64° half angle and for source-receiver distances ranging from 0.51 to 13.71 miles. By extrapolation of the results to the case of a receiver with field of view of 90° half angle, attenuation coefficients for aureoled transmission from a $4-\pi$ source to a flat receiver facing the source were determined. A plot of transmissivity vs. distance, which is expected to be applicable to the thermal radiation from a low air burst of nuclear weapon, is derived and compared with previously published plots of a similar type. (auth)

26061 CEA-tr-R-222

MECANISME PROVOQUANT LE DÉBUT DE L'ÉBULLITION DE SYSTEMES LIQUIDES METASTABLES SOUS L'ACTION DU RAYONNEMENT IONISANT (LETTRE). (Mechanism of Initiation of Boiling in Metastable Liquid Systems under the Action of Ionizing Radiation). G. A. Askar'yan (Askariane). Translated into French from Zhur. Eksptl'. i Teoret. Fiz. 31, 897-9(1956). 7p.

A concentration of like-charged ions induces the seeds for microcapture of a solution. The role of the electric poles of the ions is manifest in repulsion and in bonding of ions and molecules. Calculations are given and discussed with regard to bubble formation in bubble chambers. (T.R.H.)

26062 CEA-tr-R-775

RECHERCHES SUR L'INFLUENCE DES DIMENSIONS DE LA CHAMBRE DE DÉCHARGE ET DE LA FORME DES ÉLECTRODES SUR LES MODALITÉS DE L'ALLUMAGE ET DE L'EXTINCTION D'UNE DÉCHARGE À HAUTE FRÉQUENCE DANS L'HYDROGÈNE. (Research on the Effect of Chamber Dimensions on the Discharge and of the Shape of the Electrodes on the Modalities of Ignition and Extinction of a High-Frequency Discharge in Hydrogen). Kh. A. Dzherpetov (Djerpetov). Translated into French by S. Mayer from Vestnik Moskov. Univ., Ser. Mat., Mekhan., Astron., Fiz. i Khim. 12, No. 5, 111-20 (1957). 18p.

A study was made of the effects of electrode shape and discharge-chamber dimensions on the ignition and extinction characteristics of discharges in H_2 at 0.6 to 30 Mc and pressures of 0.1 to 10 mm Hg. The ignition potential vs.

pressure becomes smaller as the frequency goes from 8.8 to 30 Mc. This potential depends strongly on the shape of the electrodes. The curves of ignition potential vs. pressure have two minima related to electrode shape and discharge-chamber length. The form of the extinction potential vs. pressure curve can be similar to the one for ignition. (T.R.H.)

26063 JPRS-5118

INVESTIGATION OF THE POSSIBILITY OF USING A NON-HOMOGENEOUS MAGNETIC FIELD FOR THE FORMATION OF HIGH-DENSITY ELECTRON BEAMS. Yu. V. Troitskiĭ (Troitskiy). Translated from Zhur. Tekh. Fiz. 30, 512-21(1960). 22p. OTS.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 19659.

26064 JPRS-5124(p.151-9)

THE USE OF CRYSTALS OF POTASSIUM BROMIDE FOR DOSIMETRY OF γ -RADIATION. V. S. Bubnov, I. B. Keirim-Markus, and T. N. Smirnova. Translated from Med. Radiol. 5, No. 3, 61-4(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 13885.

26065 NASA-TT-F-7

National Aeronautics and Space Administration, Washington, D. C.

SOME RESULTS OF THE MEASUREMENT OF THE SPECTRUM MASS OF POSITIVE IONS BY THE 3RD ARTIFICIAL EARTH SATELLITE. V. G. Istomin. Translated from the Russian. Apr. 1960. 20p. (AD-235413). OTS.

The radio-frequency mass spectrometer installed in the third satellite registered positive ions with mass values of 32, 30, 28, 18, 16, and 14 which were identified as single charged ions of molecular oxygen, nitrogen oxide, molecular nitrogen, atomic oxygen, and atomic nitrogen, respectively. The data obtained ranged from altitudes of 225 to 980 km and latitudinal intervals of 27 to 65° north latitude. Certain patterns in the changing composition of the ionosphere with altitude and geographic latitude were discovered. (auth)

26066 UCRL-Trans-490(L)

THE EFFECT OF GEOMETRY ON THE HALL EFFECT IN THE CASE OF RECTANGULAR SEMICONDUCTING PLATES. Hans-Joachim Lippmann and Friedrich Kuhrt. Translated by Esther Fultz from Z. Naturforsch. 13a, 474-83(1958). 31p. JCL.

The Hall potential of a rectangular semiconducting plate with current passing through it, located in a transverse magnetic field, is calculated by solving the potential problem. The resulting expression for the Hall potential is the product of the Hall potential of the infinitely elongated plate and a geometry function that depends on the ratio of the sides of the rectangle a/b and the Hall angle θ . For small and large Hall angles, analytical expressions for the geometry functions are derived; in the intermediate region between small and large θ values, this function is inferred by means of numerical evaluation of the integral appearing in the geometry function. (auth)

26067 UCRL-Trans-528(L)

A CYCLOTRON ION SOURCE. H. Baumgartner, P. C. Gugelot, P. Scherrer, C. R. Extermann, and P. Preiswerk. Translated by W. D. Kilpatrick from Helv. Phys. Acta. 15, 333-4(1942). 3p. JCL.

A cyclotron ion source composed of an expanded hot cathode, an acceleration electrode (cylinder with grid), and a counter electrode with exhaust capillary is described.

The ion source is fed through a hole in the magnet yoke and vacuum wall in the acceleration chamber. (C.J.G.)

26068 UCRL-Trans-555

MAGNETIC SUSCEPTIBILITY OF SOLID OXYGEN AT LOW TEMPERATURES. A. S. Borovik-Romanov. Translated from *Zhur. Eksptl'. i Teoret. Fiz.* **21**, 1303-8(1951). 11p. JCL or LC.

Absolute values of magnetic susceptibility of liquid oxygen at 77°K and of solid oxygen at 20°K were measured. Temperature dependence of the susceptibility of solid oxygen between 20 and 14°K and between 4.2 and 1.5°K was also studied. It was established that the value of oxygen susceptibility reduces by 9% according to the quadratic law from 20 to 14°K, preserves the same value at 4.2°K, which at 14°K reveals between 4.2 and 1.5°K a slight linear increase reaching ~5%. The research was conducted by modifying the ballistic method with a breaking of the galvanometer's circuit, which permits a sensitivity increase of almost one order. (auth)

26069 UCRL-Trans-564(L)

THE THEORY OF PHOTOELECTRIC EMISSION. P. Görlich and H. Hora. Translated from *Optik* **15**, 116-26(1958). 11p. JCL.

Reasons are given why a distinction must be made between the photoelectric emission of metals in the long-wave region (conduction-band photoelectric emission) and the emission of electrons of localized states (local-level photoelectric emission). The latter seems to be present from the visible region onward in Cs_3Sb cathodes. The phenomenological theory known for Cs_3Sb was applied, in accordance with known measurements, to the photoelectric emission of metals in the far ultraviolet. The consistency of the measurements is satisfactory and indicates that analogous conditions must prevail in the emission of Cs_3Sb and that of metals in the far ultraviolet. Application of the phenomenological theory to the conduction-band photoelectric emission of metals was taken into consideration in principle, and the difficulties involved in strict verification were indicated. (auth)

26070 UCRL-Trans-574(L)

CONSTRUCTION OF A PROTON SOURCE WITH LOW ARC VOLTAGE. D. Porte. Translated by W. D. Kilpatrick from *Compt. rend.* **245**, 2233-6(1957). 6p. JCL.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 12, as abstract No. 6054.

26071 UCRL-Trans-575(L)

AN ANALOGY BETWEEN ION SOURCE OPERATION AND PROBES AT HIGH FREQUENCIES. F. Bertin and A. Pozwolski. Translated by Wallace D. Kilpatrick from *Compt. rend.* **242**, 2517-19(1956). 4p. JCL.

An experiment is described in which ions and electrons diffusing through a hole in a metallic diaphragm situated in the end of a low-pressure gas-containing tube are collected. The current collected at any time depends on the pressure in the discharge tube and on the potential difference between the diaphragm and the Faraday collector cage. The analogy of results obtained in this experiment with those obtained using electric probes is explained. (J.R.D.)

26072 UCRL-Trans-576(L)

SOURCE OF DOUBLY IONIZED HELIUM IONS. R. Geller and F. Prevot. Translated by Wallace D. Kilpatrick from *Compt. rend.* **238**, 1578-80(1954). 3p. JCL.

Production of an intense beam of α particles (He^{2+}) by use of an electrostatic accelerator is described. The pro-

cedure can be used to obtain a sheet of gas with controllable density, perfectly localized and permanently renewed without augmenting the residual pressure in the accelerator tube. (J.R.D.)

26073 UCRL-Trans-577(L)

THEORY OF ION SOURCES WITH OSCILLATING ELECTRONS. Max Hoyaux. Translated by Wallace D. Kilpatrick from *J. phys. radium* **15**, 264-72(1954). 19p. JCL.

A review of laws governing ion sources with oscillating electrons is presented. The fundamental hypothesis of the presentation is that the electronic space charge is almost entirely offset by the ionic space charge. The state in which electronic and ionic currents are very weak and which corresponds approximately to a pure electronic discharge, and another state in which the currents are very much greater and which corresponds to a bipolar discharge are examined. (auth)

26074 UCRL-Trans-578(L)

THEORY OF IONIZED MEDIA WITH TRANSLATIONAL SYMMETRY. Max Hoyaux. Translated by W. D. Kilpatrick from *Rev. gen. elec.* **60**, 279-91(1951). 61p. JCL.

A theory for electrical discharge in weakly ionized low-pressure gases is presented. A study of the statistical properties of the ionized media leads to equations of general mobility and to their extension for the case of bipolar media. The relations obtained are then applied to the media with translational symmetry, from which fundamental equations valid for bunches and for small variations are obtained. Particular cases considered are that of a positive column of revolution and that of the residual plasma. Experimental verification was carried out by use of a device for displaying the characteristics of probes in a periodically variable medium. (auth)

26075 UCRL-Trans-579(L)

A NEW ELECTRON SOURCE AND ITS INVERSION AS AN ION SOURCE. R. Keller. Translated by W. D. Kilpatrick from *Helv. Phys. Acta* **21**, 170(1948). 4p. JCL.

An electron source which is based on the ion-gage principle of Penning is described. By inverting the polarity of the accelerator electrode, the apparatus serves as an ion source. (C.J.G.)

26076 UCRL-Trans-580(L)

A NEW ELECTRON SOURCE AND ITS INVERSION AS AN ION SOURCE. P. Lorrain. Translated by W. D. Kilpatrick from *Helv. Phys. Acta* **21**, 497-8(1948). 4p. JCL.

A source which is capable of producing either an ion beam or an electron beam is described. A magnesium cathode is used which provides a stable, easily ignited discharge. The ion beams are of several ma, and the energy spread is a few volts. (J.R.D.)

26077 UCRL-Trans-581(L)

ANALYSIS OF AN ION SOURCE WITH 60 KV ACCELERATION VOLTAGE. P. Huber and F. Metzger. Translated by W[allace] D. Kilpatrick from *Helv. Phys. Acta* **19**, 200-2(1946). 4p. JCL.

A preferred canal design for ion sources is presented. Parameters for this design are such that in relation to its atomic ion yield, a 60 to 65 kv gas discharge voltage and about 18 ma discharge current with canal currents up to 1.2 ma are obtained. The magnetically deflected proton current amounts to 550 to 650 μ a. (J.R.D.)

26078 UCRL-Trans-585(L)

A NEUTRON GENERATING TUBE WITHOUT VACUUM PUMPS. F. M. Penning and J. H. A. Moubis. Translated by W. D. Kilpatrick from *Physica* **4**, 1190-9(1937). 14p. JCL.

A discharge tube is described for the excitation of neutrons by bombardment of a (Zr-D) target with D_2 ions. It was found that by means of a magnetic field it was possible to maintain the glow discharge, used as ion source, at a pressure of only 10^{-3} mm (and a potential difference of a few kv), so that no pumping is needed between the ion source and the part of the tube where the ions are accelerated. The number of neutrons produced by this tube was in one case equivalent to that of about 10 mc Ra-Be. (auth)

26079 UCRL-Trans-586(L)

A SIMPLE ARRANGEMENT FOR NEUTRON GENERATION. C. Weiss and H. Westmeyer. Translated by W. D. Kilpatrick from *Physik*, **Z.** 40, 461-6(1939). 12p. JCL.

A neutron-generation apparatus is described which employs a low-voltage arc with a hot tungsten cathode in deuterium gas. The neutrons were produced by the $2D^2 \rightarrow He^3 + n$ reaction on a D_3PO_4 target. Neutron production in continuous operation is equivalent to 1g (Rn + Be). (C.J.G.)

26080 UCRL-Trans-587(L)

MONOENERGETIC ION BEAMS FROM THE GLOW-DISCHARGE OF THE HOLLOW CATHODE. M. Pahl and W. Kleinmann. Translated by W. D. Kilpatrick from *Ann. Physik* (6), **13**, 166-77(1953). 25p. JCL.

A Schüller hollow cathode (2 cm in diameter) was designed with a circular diaphragm (0.5 mm in diameter) and a variable electrical potential. The extracted ion current (about 10 μ a) through the diaphragm was accelerated by fields at 300 to 1000 volts, and its energy was measured by means of a deceleration method in an electrostatic lens-tube system as a function of parameters such as gas pressure, extraction voltage, and others. The narrowest energy distribution occurs when the ions go through the diaphragm without the extraction field. Details of experimental curves using H_2 , N_2 , and He are examined. (auth)

26081 UCRL-Trans-588(L)

A HIGH FREQUENCY DISCHARGE ION SOURCE. Hugo Neuert. Translated by W. D. Kilpatrick from *Z. Naturforsch.* **4a**, 449-55(1949). 17p. JCL.

An ion source in which ions are produced by an electrodeless high-frequency gas discharge with pressures of 1 to 10×10^{-3} mm and extracted by d-c voltages up to 10 kv is described. Ion currents of 15 ma are easily produced. (C.J.G.)

26082 UCRL-Trans-590(L)

PRODUCTION OF AN INTENSE BEAM OF NEUTRONS. F. Prevot and R. Vienet. Translated by W. D. Kilpatrick from *J. phys. radium* **16**, 238(1955). 4p. JCL.

Issued in French as CEA-383 (reprint).

An intense beam of neutrons was produced by a small Van de Graaff accelerator, under pressure, which is equipped with a pulsed ion source. The source is of the cold-cathode discharge type in an axial magnetic field of 200 gauss. With the apparatus, a deuteron beam of >9 ma can be focused on a suitable target at 2.5 m from the source. The energy of the deuteron is ~ 1.55 Mev. (C.J.G.)

26083 UCRL-Trans-591(L)

THERMAL ION SOURCES FOR NEGATIVE IONS. H. Hintenberger. Translated by W. D. Kilpatrick from *Helv. Phys. Acta* **24**, 307-9(1951). 5p. JCL.

Thermal sources for negative ions are examined, and the limitations of various elements for use in this area are discussed. A convenient metal for negative-ion formation appears to be thorium. Data are presented for comparison of ion emission from activated thorium with that of activated tungsten. (J.R.D.)

26084 UCRL-Trans-594(L)

A NEW PRINCIPLE FOR ION SOURCES OF HIGH INTENSITY. J. Sommeria. Translated by W[allace] D. Kilpatrick from *J. phys. radium* **12**, 563-4(1951). 4p. JCL.

The design of an annular high-intensity ion source is described in which an increase in ion production can be achieved without the use of cold cathodes, by use of a self-regulating discharge. (J.R.D.)

26085 UCRL-Trans-595(L)

A MODEL OF A MAGNETIC-FIELD TYPE DEUTERIUM SOURCE. G. Perona and A. Persano. Translated by M. Kilpatrick from *Nuovo cimento* (10) **1**, 501-3(1955). 9p. JCL.

Results and conclusions obtained in investigations of various ion sources with oscillating electrons in axial magnetic fields are presented. A schematic model of a source for a 400-kev ion accelerator and data on current extraction are included. (J.R.D.)

26086 UCRL-Trans-596(L)

RADIO-FREQUENCY ION SOURCE. Fernando Alba Andrade, Eduardo Diaz Losada, Alonso Fernandez, and Indalecio Gomez. Translated by M. D. Kilpatrick from *Rev. mex. fis.* **3**, 107-14(1954). 7p. JCL.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 12, as abstract No. 6080.

26087 UCRL-Trans-597(L)

A NEW EXTRACTION PRINCIPLE FOR ION SOURCES. APPLICATION TO DIFFERENT TYPES OF SOURCES. J. Sommeria. Translated by W. D. Kilpatrick from *J. phys. radium* **13**, 491(1952). 5p. JCL.

An extraction principle for ion sources and its applications are described. An arrangement with a cathode lens in which a very large surface of the ionized volume is concerned with extraction is proposed. In this system the diaphragm is at the lens focus, i.e., at the increase of the ion trajectories, and thus constitutes the object of the lens system. (J.R.D.)

26088

THE MAGNETO-DYNAMIC ADIABATIC EQUILIBRIUM OF A GRAVITATING GASEOUS FLUID MASS IN NON-UNIFORM ROTATION. Cataldo Agostinelli. *Atti accad. nazl. Lincei. Rend., Classe sci. fis., mat. e nat.* **28**, 278-83(1960) Mar. (In Italian)

The equation of the magneto-adiabatic equilibrium was established previously (*Rend. acad. naz. Lincei* **26**, (1959)) for a gaseous mass with infinite electrical conductivity, in which a magnetic field is generated by the effect of the conduction current and which is rotating uniformly internally about a baricentric axis. In the present work, it is shown how, in the case of nonuniform rotation, the equations of relative equilibrium of the gaseous mass are modified. (J.S.R.)

26089

DIRAC CONTINUUM RADIAL WAVE FUNCTIONS. H. S. Perlman and B. A. Robson (Univ. of Melbourne). *Australian J. Phys.* **12**, 30-41(1959) Mar.

Tables of Dirac continuum radial wave functions for an electron in the Coulomb field of a mercury nucleus ($Z = 80$) are presented for several energies and l 's. Approximate methods of interpolation and extrapolation to regions not covered explicitly are indicated. (auth)

26090

ELECTRON MOBILITY IN LIQUID ARGON. F. D. Stacey (Australian National Univ., Canberra). *Australian J. Phys.* **12**, 105-8(1960) Mar.

The drift velocity of electrons in liquid argon to which an electric field was applied was found to be essentially independent of the electric field. If the electrons remained free their mobility and drift velocities would be proportional to the applied electric field. The constant electron velocity was strongly suggestive of an attachment process in which

heavy negative ions of very short lifetime were formed. The cross section for the capture of electrons by neutral argon atoms and the attachment energy were calculated. It was found that the lifetime of the heavy negative ion is long by comparison with that of the free electron. (M.C.G.)

26091

THE STRUCTURE OF A STREAM OF ELECTRONS AND IONS DRIFTING AND DIFFUSING IN A GAS WHEN IONIZATION BY COLLISION AND MOLECULAR ATTACHMENT ARE PRESENT. L. G. H. Huxley (Univ. of Adelaide). Australian J. Phys. **12**, 171-83(1959) June.

The theory was developed of the structure of a stream of electrons and ions drifting under the action of a uniform field and diffusing in a gas when either or both ionization by collision and electron attachment are present. The cases considered include a point source and a line source, and in the latter case the influence of a magnetic field is discussed. The investigation provides a theoretical basis for methods of measuring electron attachment about to be put into practice. (auth)

26092

EMISSION OF NEGATIVE IONS OF OXYGEN DURING THE ACTIVATION OF OXIDE-COATED CATHODES. N. A. Surplice (University Coll. of North Staffordshire, Keele, Eng.). Brit. J. Appl. Phys. **11**, 430-3(1960) Sept.

Oxide-coated cathodes were used as ion sources in a simple mass spectrometer and were found to emit atomic negative ions of oxygen during their activation at high temperatures (1150 to 1275°K). A retarding potential at the collector was used to separate the ions emitted by the cathode from the ions formed in the residual gas. Most of the oxygen ions from the cathode arrived at the collector with more energy than they could have obtained from the potential difference across the electron gun, and their number increased as the cathode became more active. The evidence suggests that the ions were formed by dissociation of the oxide coating, then diffused to the surface and were removed by positive ion bombardment. Such a process would leave oxygen vacancies in the oxide which would act as electron donors and increase its electron emission. (auth)

26093

THE DIRECT CONVERSION OF NUCLEAR ENERGY TO ELECTRICAL ENERGY. Nguyen Van Dong. Bull. inform. sci. et tech. (Paris) No. 41, 14-27(1960) June. (In French)

The methods for the conversion of nuclear energy into electrical energy are radioactive P-N junction cells, thermoelectric phenomena in semiconductors, and the thermoelectric effect in metals. Each of these methods is described, and the electric power and conversion yield are studied. (tr-auth)

26094

ON THE CONFIGURATION fd^2 OF THORIUM II. Josef B. Ganz (Hebrew Univ., Jerusalem). Bull. Research Council Israel, Sect. F, **9**, 31-42(1960) June. (In English)

The energy levels of fd^2 configuration of Th II were calculated by Racah's tensor operators' method and compared with the experimental data. Intermediate coupling was used without configuration interaction. The observed levels were assigned to terms with the aid of the calculated levels. (auth)

26095

THE STABILITY OF DYNAMIC SYSTEMS AND THE SCHRÖDINGER EQUATION. Nicholas Chako. Compt. rend. **251**, 645-7(1960) Aug. 1. (In French)

A rigorous examination is made of the conditions that a

dynamic system must satisfy in order that a wave equation associated with this system can be found. It is shown that the characteristic exponents play a basic role in the derivation of wave equations associated with the corresponding classical system. (J.S.R.)

26096

OBTENTION OF A CONTINUOUS ELECTRIC CURRENT FROM A JET OF IONIZED VAPOR. Siegfried Klein. Compt. rend. **251**, 657-9(1960) Aug. 1. (In French)

An efficient separation of positive and negative electric charges can be obtained from ionized vapors of mercury or from other substances. Under pressure, these ionized vapors enter by a pipe in an expansion chamber provided with several electrodes in which a vacuum of 10^{-3} mm Hg was obtained. This fluid composed of molecules, ions, and electrons passing over the electrodes diffuses in an unequal fashion and an emf arises between the electrodes. (tr-auth)

26097

INFLUENCE OF THE TREATMENT CONDITIONS ON THE PARASITIC DIFFUSION IN NUCLEAR EMULSIONS.

Jacques Bermond, Claudette Patou, and Maurice Scherer (Faculté des Sciences, Caen, France). Compt. rend. **251**, 700-2(1960) Aug. 1. (In French)

The effect of different parameters of the treatment of nuclear emulsions on the parasitic diffusion is investigated. In particular, glycerination, drying, and the development temperature are studied. (tr-auth)

26098

PHOTOLUMINESCENCE WITHIN THE FUNDAMENTAL ABSORPTION EDGE OF MIXED CdSe-CdS CRYSTALS. E. F. Gross and V. V. Sobolev (Inst. of Physics and Tech., Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R. **133**, 56-9(1960) July 1. (In Russian)

The photoluminescence of large crystals of CdSe-CdS, monocrystals of CdSe, and large crystal layers of CdSe and CdS was investigated at the self-absorption edge. All specimens had hexagonal structure. The spectra were taken at 77.3 and 4.2°K with a spectrometer of 50 and 13 Å/mm dispersion at 7000 Å. At 4.2 to 77.3°K the emission spectra of mixed layers is dampened, the legibility of complex line emission is disturbed (at 77.3°K the mixed layer line emission appears on a band and only with 96% CdSe-4% CdS does it retain a doublet structure); and, the intensity of short-wave lines is sharply reduced. As the temperature is increased from 4.2 to 77.3°K, the doublet and triplet components increase and long-wave components diminish. (R.V.J.)

26099

ON THE DISPERSION OF A CONDUCTING GAS FLOWING IN A MAGNETIC FIELD. V. B. Baranov. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Mekh. i Mashinostr. No. 4, 14-18(1960) July-Aug. (In Russian)

The problem of the dispersion of a conducting gas flowing in a magnetic field is considered in the basic equations of magnetohydrodynamics. Formulas and calculated graphs are obtained for the distribution of velocities, density, pressure, and temperature along the canal length for three cases: the dispersion in a canal of constant cross section, isothermal dispersion, and dispersion in a slowly broadening canal. The cases are considered when the magnetic field induced in the conducting gas may be neglected and the viscosity is not taken into account. In the engineering of the well-known pumps for pumping liquid metals, the electromagnetic force is utilized to move the liquid metals along a pipe. One of these pumps was designed at the Institute of Physics of the Latvian Academy of Sciences. For pumping

liquid sodium, an inductor was utilized, originally flowing along a canal in a magnetic field whose direction was perpendicular to the direction of its motion. The rate of the spreading of the field may be increasing through the frequency rise caused by the induced electrical current. A weakly conducting gas with velocity of the order of 10-12 km/sec is required to investigate the possibility of dispersion. The strength of the external electric field E is believed equal to zero. All quantities taken into consideration depend only on the coordinate X along the canal. (TTT)

26100

CALCULATION METHODS FOR EFFECTIVE CROSS SECTIONS OF ELECTRON EXCITED ATOMS. L. A. Vainshtein and I. I. Sobel'man (Lebedev Inst. of Physics, Moscow). *Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz.* **24**, 943-5 (1960) Aug. (In Russian)

A general equation for the theory of atomic interactions with electrons and characteristics of the approximation method are analyzed. The interaction theory is reduced to the solution of a Schwinger equation for the wave function ψ of an n -electron atom-outer electron system. For practical purposes the ψ is reduced to a set of functions of $\psi(\Gamma)$ with angular and radial outer electron variables with complete moments; $\Gamma = \gamma\alpha S k l' \frac{1}{2} \alpha_T S_T$, the quantum number $\gamma\alpha S$ describes the state of the atom, $k l' \frac{1}{2}$ is the quantum number of the outer electron partial wave, and $\alpha_T S_T$ is the orbital and spin moments of the system. Assuming that the atomic wave function is known, an attempt was made to find the radial portions of outer electron-wave functions $F_r(r)$. (R.V.J.)

26101

HYDROGEN ATOM DIFFERENTIAL EXCITATION CROSS SECTIONS. R. K. Peterkop. *Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz.* **24**, 946-9 (1960) Aug. (In Russian)

Differential cross sections of excited levels in continuous and discrete hydrogen spectra were studied by Born approximation. (R.V.J.)

26102

FURTHER STUDIES OF RESONANCE CHARGE IN POSITIVE CESIUM IONS. R. M. Kushnir and I. M. Buchma (L'vov State Univ.). *Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz.* **24**, 986-8 (1960) Aug. (In Russian)

Further studies were made of cesium ion resonance charge at high energies. Measurements were made by extracting slow ions formed in cylindrical electrodes. The charge cross sections as functions of ion velocities were studied at ion energies of 100, 200, 400, 700, 900, 1200, 1600, and 2000 eV under various saturation vapor pressures at 90 to 115°. The effective cross sections at the above energies were: 1100, 910, 835, 790, 775, 725, 695, and 690. Experimental and theoretical data are correlated and plotted. (R.V.J.)

26103

SURFACE CLEANING BY CATHODE SPUTTERING. O. C. Yonts (Oak Ridge National Lab., Tenn.) and Don E. Harrison, Jr. *J. Appl. Phys.* **31**, 1583-4 (1960) Sept.

Evidence is presented to indicate that surface recontamination from background gases may be a significant factor in quantitative sputtering measurements, even for beam current densities of 0.1 ma/cm² and operating pressures of 5×10^{-6} mm Hg. An oversimplified mechanism is discussed which leads to criteria for a clean-surface sputtering experiment. (auth)

26104

NEGATIVE HYDROGEN AND DEUTERIUM ION BEAMS.

Sanborn F. Philp (Massachusetts Inst. of Tech., Cambridge). *J. Appl. Phys.* **31**, 1592-6 (1960) Sept.

The charge state of a monoenergetic beam of hydrogen atomic and molecular ions traversing a hydrogen gas target was measured as a function of the energy of the beam and the thickness of the gas target. The yield of negative ions from protons had a maximum of 1.5% at 13 keV. From diatomic and triatomic molecular ions the maximum yields were 3.0 and 4.5% at 26 and 39 keV, respectively. The experiments were also performed with deuterium ions traversing the hydrogen gas target. The deuterium results were almost identical with those of hydrogen if the energy scale for the hydrogen data was multiplied by two. (auth)

26105

QUANTUM MECHANICAL (PHASE SHIFT) ANALYSIS OF DIFFERENTIAL ELASTIC SCATTERING OF MOLECULAR BEAMS. Richard B. Bernstein (Univ. of Michigan, Ann Arbor). *J. Chem. Phys.* **33**, 795-804 (1960) Sept.

For a spherically symmetrical intermolecular potential $V(r) = \epsilon f(r/\sigma)$, the quantum calculation of the elastic scattering cross section $d\sigma(\theta)/d\Omega$ in the cm system is carried out as follows. For a given relative velocity (or deBroglie wavelength) and an assumed $V(r)$, the radial wave equation is integrated for successive values of the angular momentum quantum number l , yielding the phase shifts η_l . Then $d\sigma(\theta)/d\Omega$ is computed in terms of the series of η_l 's in the standard way. A general computational program (following that of K. Smith) is outlined for the evaluation of the radial wave function and the phase shifts. Calculations are presented for the L-J (12,6) potential function. The results may be concisely represented using the framework provided by the semiclassical treatment of Ford and Wheeler (i.e., in terms of a set of reduced phase constants as a function of reduced angular momenta at various reduced relative kinetic energies K). Tables and graphs are presented from which the phases may be obtained to a good approximation for any given ϵ , σ , and K . Computation of the differential and total cross sections from the phase shifts is then readily accomplished. The results are compared with the classical and semiclassical treatments. The problem of tunneling and orbiting is discussed. (auth)

26106

PAIR DISTRIBUTION FUNCTION OF A HARD SPHERE BOSE SYSTEM CALCULATED BY THE PSEUDO-POTENTIAL METHOD. Leopoldo S. Garcia-Colin (Univ. of Maryland, College Park). *J. Math. Phys.* **1**, 87-96 (1960) Mar.-Apr.

The pair distribution function for a hard sphere Bose system was calculated by using a method in which the hard sphere potential was replaced by the so-called pseudo-potential. The problem was carried through using the quasi-particle formalism of Bogoliubov. In this calculation a system of bosons was considered interacting via the pseudo-potential, which can be regarded as a weak interaction when the system is very dilute. The Hamiltonian of the system was diagonalized by means of a canonical transformation that had the effect of separating the energy into two parts, one of which was the ground state energy and the other corresponded to an ideal Bose gas composed of "elementary excitations" or "quasi-particles." This formalism was applied to the calculation of the pair distribution function. This quantity was calculated by averaging over a grand canonical ensemble constructed with the total number of elementary excitations. A result that was seen to be valid both for the condensed and gaseous phases of the system and also for any distance r between the particles

was obtained. A discussion of the difference between these results and the ones obtained in a previous calculation and a comparison between both results and the experimental ones are also given. (auth)

26107

ON THE PAIR DISTRIBUTION FUNCTION OF A HARD SPHERE BOSE SYSTEM. Leopoldo S. Garcia-Colin and Jean Peretti (Univ. of Maryland, College Park). *J. Math. Phys.* **1**, 97-106(1960) Mar.-Apr.

The pair distribution function for a quantum Bose gas is expressed as a power series in terms of the fugacity, the coefficients of which are temperature dependent. For the hard sphere case, these coefficients were evaluated to the first order in a/λ (a being the scattering length and λ the thermal wavelength) by using torons with two fixed points or alternatively U cluster functions. The result gives the first order correction to the ideal gas formula of London and Placzek introduced by the interactions between the particles. (auth)

26108

FORMAL SOLUTION OF LIOUVILLE'S EQUATION. Oldwig von Roos (California Inst. of Tech., Pasadena). *J. Math. Phys.* **1**, 107-11(1960) Mar.-Apr.

A formal solution of Liouville's equation both for the classical and for the quantum mechanical case is presented. The derivation follows closely the approach employed by Feynman in his papers on the theory of positrons. A scattering operator S was found which connects the distribution function at time t' with the distribution function at any later time t . Each term of this scattering operator can be represented uniquely and conveniently by a diagram. The topological structure of these diagrams is the same in the classical as well as in the quantum mechanical case. (auth)

26109

AN EXTENDED ADIABATIC INVARIANT. S. Tamor (General Electric Research Lab., Schenectady, N. Y.). *J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research* **1**, 199-205(1960) July.

The motion of a one-dimensional oscillator with time-dependent restoring force was investigated. The function $\omega(t)$ having one singularity for finite t and such that

$$\lim_{|t| \rightarrow \infty} \left| \frac{d}{dt} \omega^{-1}(t) \right| = 0$$

and the asymptotic behavior of ω times the square of the amplitude were considered. The ratio of this quantity evaluated at two times, t_1 and t_2 , averaged over an ensemble was in the limit $|t_1|, |t_2| \rightarrow \infty$ an adiabatic invariant in the sense that this quantity was not changed by multiplication of ω by a slowly varying function of t . This permitted replacement of the actual $\omega(t)$ by a, presumably simpler, $\omega_0(t)$ if their ratio, ω_0/ω was non-singular. Since the orbit equation for a charge in a time-dependent axisymmetric magnetic field was reducible to that of a one-dimensional oscillator it possessed such an invariant. This problem is examined in some detail, particularly for the model field $\omega(t) = \omega_0 t$. These solutions provide explicit estimates for the energy gained by a charge under a reversal of the magnetic field. (auth)

26110

MEASUREMENT OF THE INTENSITY IN ELECTRON DIFFRACTION BY A CdS SINGLE CRYSTAL. Satio Takag and Fuminori Fujimoto (Tokyo Univ.). *J. Phys. Soc. Japan* **15**, 1607-14(1960) Sept. (In English)

A method of measuring the electron intensity in electron diffraction patterns by the electron-bombardment-induced-current in a CdS single crystal is described. The CdS detector is moved in the diffraction camera by a screw which is driven by a synchronous motor. Electron-bombardment-induced-current is measured directly by an automatic recording millivoltmeter. Electron-bombardment-induced-current properties of good crystals selected from those prepared by Frerichs' method are given. It is shown that the intensity can be measured within 2 to 3% error, if suitable precautions are made. An example of the measurement on TiCl is also given. (auth)

26111

AN ELECTRON-DEPOSITION ION SOURCE WITH EXCLUSION OF THE SAMPLE VAPOR FROM THE DISCHARGE CATHODE. M[anfred] von Ardenne and K. Steinfelder (Forschungsinstitut Manfred von Ardenne, Dresden-Weisser Hirsch, Ger.). *Kernenergie* **3**, 717-21(1960) Aug. (In German)

The construction and performance of an electron-deposition ion source are described in which practically none of the sample vapor reaches the very-hot cathode or its surroundings. A cold vapor-condensing tube is used between the electron deposition space and the cathode chamber. The effectiveness of the arrangement is demonstrated using anthracene. (T.R.H.)

26112

DENSITY COMPRESSION RATIO ACROSS RELATIVISTIC-STRONG-SHOCK WAVES. Arnold W. Guess (Air Force Cambridge Research Center, Bedford, Mass.). *Phys. Fluids* **3**, 697-705(1960) Sept.-Oct.

The relativistic Rankine-Hugoniot shock wave conditions of Taub were extended to include radiation pressure and energy density. Specialization to the situation of a nonrelativistic ambient gas gave strong shocks. Solutions were obtained separately for the cases of a pure material gas and a pure radiation gas behind the shock. The material gas was considered to have a constant adiabatic exponent $\gamma \leq 2$, or to be itself relativistic, and the value $\gamma = 4/3$ gave the radiation gas results. The rest density compression increased above its nonrelativistic strong shock limit $(\gamma + 1)/(\gamma - 1)$, by a term proportional to β^2 in the lowest order, where β is the ratio of shock velocity to light velocity. As $\beta \rightarrow 1$ (extreme relativistic strong shock) the rest density compression goes as $1/(1 - \beta^2)^{1/2}$, but there is no setting-in of degeneracy in the shocked gas. In shock coordinates, the flow velocity ratio across the shock (front to back) decreases monotonically from its nonrelativistic limit and approaches the value $1/(\gamma - 1)$ as $\beta \rightarrow 1$. An expression was obtained for the velocity of relativistic sound wave propagation in a mixture of a thermally perfect material gas and a radiation gas. (auth)

26113

TRANSPORT PROPERTIES OF HELIUM II IN FINE CHANNELS. J. Burnham, J. Reppey, G. Pearson, A. H. Spees, and C. A. Reynolds (Univ. of Connecticut, Storrs). *Phys. Fluids* **3**, 735-41(1960) Sept.-Oct.

The thermal conductivity of liquid He II in the interstices of a column of packed jeweler's rouge (Fe_2O_3 powder) was found to have a temperature dependence: $k \propto T^n$, where n falls monotonically from a value of 13 at 1.5°K to possibly zero at the lambda point. The value of the thermal conductivity at the lambda point is 0.60 ± 0.03 w/cm°K. From the flow of helium, nitrogen, and water at room temperature it was estimated that a typical rouge column provides the equivalent of about 1.4×10^9 parallel channels having an average diameter of $0.18 \pm 0.02\mu$. The viscosity of the nor-

mal component of He II, computed from the measured conductivity on the basis of the two-fluid model, follows a temperature dependence very similar to that observed for the bulk liquid and for 52 and 108 μ capillaries above 1.9°K. The magnitude of the values, however, is lower, but in agreement with that obtained in Leiden with 0.7 μ slits. Empirical values of a correcting slip coefficient are smaller in magnitude (0.007 μ) and less temperature dependent ($-0.018\mu/^{\circ}\text{K}$) than theoretical values calculated at Oxford. It was not possible, though, to rule out a phonon mean free path effect of the order of magnitude calculated by Atkins. Points on the lambda line were determined from the fountain effect for pressures below 0.4 atm. The slope of the line is approximately $-70 \text{ atm}/^{\circ}\text{K}$, in agreement with the slope determined at higher pressures by other means. (auth)

26114

HYDROMAGNETIC RESONATORS. Ryszard Gajewski and O. K. Mawardi (Massachusetts Inst. of Tech., Cambridge). *Phys. Fluids* **3**, 820-8(1960) Sept.-Oct.

The behavior of hydromagnetic waves in a cylindrical resonator of arbitrary cross section was examined. The conducting fluid inside the resonator was permeated with a steady uniform magnetic field parallel to the generators of the cylinder. The equation describing the eigenfrequency spectrum was derived for all possible modes and types of waves. It was shown that a TLA (transverse longitudinal acoustic) type wave when reflected from a rigid conducting termination generates an accompanying TLM (transverse longitudinal magnetohydrodynamic) type wave and vice versa. Energy losses due to the finite viscosity and electrical conductivity of the fluid as well as to the finite conductivity of the walls were then estimated for the case of T (purely transverse) type waves. A Q factor for T type waves was subsequently calculated. (auth)

26115

OBSERVATION OF QUANTUM EFFECTS IN THE SCATTERING OF A MONOENERGETIC LI BEAM BY A CROSSED HG BEAM. Hans U. Hostettler and Richard B. Bernstein (Univ. of Michigan, Ann Arbor). *Phys. Rev. Letters* **5**, 318-20(1960) Oct. 1.

Data on total and differential cross sections are presented, which are believed to show quantum effects. A velocity-selected beam of lithium, chosen for its small mass and large λ , was scattered by a crossed beam of mercury at 90° incidence. The dependence of the total cross section on the average relative velocity is shown graphically. Owing to the difficulty in determining the number of Hg atoms in the scattering zone, absolute total cross sections, Q , were not calculated. Typical angular distributions for Li scattering, observed in the plane of the crossed beams, are plotted as scattering intensities as a function of laboratory angle in the interior quadrant. It appears that the observed undulations are real interference effects originating from the wave nature of the interacting beams. (B.O.G.)

26116

LIQUID SCINTILLATORS. X. SOME ARYL SUBSTITUTED PHENANTHRENES AND DIHYDROPHENANTHRENES, AND RELATED p-TERPHENYLS AND p-QUATERPHENYLS. DETERMINATION OF KALLMANN PARAMETERS. Stephen P. Birkeland, Guido H. Daub, F. Newton Hayes, and Donald G. Ott (Univ. of New Mexico, Albuquerque and Los Alamos Scientific Lab., N. Mex.). *Z. Physik* **159**, 516-23 (1960). (In English)

A number of new 2- and 2,7-aryl substituted phenanthrenes, 3,4-dihydrophenanthrenes, and 9,10-dihydrophenanthrenes, as well as some related p-quaterphenyls and p-terphenyls, were tested as liquid-scintillation solutes.

Also determined were the compounds' ultraviolet-absorption spectra, ultraviolet-induced fluorescence spectra, and Kallmann parameters. On the basis of these measurements, it was possible to correlate to some degree structure and scintillation ability. Some interesting results regarding conjugation and coplanarity in the linear polyphenyls were also obtained. (auth)

26117

ABSORPTION SPECTRUM AND ZEEMAN EFFECT OF SAMARIUM MAGNESIUM NITRATE. A. Friederich, K. H. Hellwege, and H. Lämmermann (Technische Hochschule, Darmstadt, Ger.). *Z. Physik* **159**, 524-32(1960). (In German)

Five line groups in the absorption spectrum of samarium magnesium nitrate were studied at low temperatures. From the polarization of the lines and with the help of the Zeeman effect the crystal quantum numbers $\mu, \bar{\nu}$ of the crystal-field components, the angular-momentum quantum number J and the g factor of the terms, some crystal-field matrix elements, and a part of the eigenfunctions in the crystal were obtained. The Russell-Saunders-terms, arising on the basis of the Zeeman effect, were discussed and compared with theory. With the crystal-field components of the ground term $^6\text{H}_{5/2}$ the specific magnetic heat was calculated between 0 and 150°K. (tr-auth)

26118

MASS-SPECTROMETER INVESTIGATION OF THE SECONDARY POSITIVE AND NEGATIVE IONS EMISSION IN BOMBARDMENT OF Mo BY POSITIVE IONS. Ya. M. Fogel, R. P. Slabospitskiy, and I. M. Karnaukhov (Khar'kov State Univ.). *Zhur. Tekh. Fiz.* **30**, 824-34(1960) July. (In Russian)

Data are presented on the mass spectra of secondary positive and negative ions appearing in Ne^+ , Ar^+ , and Kr^+ bombardment of molybdenum. The relation of the number of secondary ions to the primary energies at 5 to 40 keV and to the target temperature was investigated. The emission restoration time after degasification in vacuum was determined for all secondary ions. Variations in the secondary emission mass spectra appearing due to the action of hydrogen and D_2O vapor additions were investigated. (tr-auth)

26119

ABOUT THE NON-STATIONARY FLOW OF THE UNCOMPRESSED VISCOUS CONDUCTING FLUID THROUGH THE SEMISPACE IN THE DIAMETRICAL MAGNETIC FIELD PRESENCE. I. B. Chekmarev (Leningrad Polytechnic Inst.). *Zhur. Tekh. Fiz.* **30**, 920-4(1960) Aug. (In Russian)

The non-stationary flow of the conducting fluid filling the semi-space above an unrestricted infinitely thin moving plate in a transverse magnetic field was studied. The lower part of the semi-space is considered to be filled with a stationary solid conductor. Laplace conversions were used to find expressions for functions of arbitrary plate motion. Simple closed-form solutions were derived for uniform or oscillatory plate motions. (tr-auth)

26120

THE STREAMLINE OF CONDUCTING FLUID ROUND A BALL IN STRONG MAGNETIC FIELD. G. Z. Gershuni and E. M. Zhukhovitskiy (Pedagogical Inst., Perm State Univ.). *Zhur. Tekh. Fiz.* **30**, 925-6(1960) Aug. (In Russian)

The streamline of conducting fluid with small Reynolds' number around a ball in a longitudinal magnetic field was studied previously by W. Chester (*J. Fluid Mech.* **3**, 304

(1957)) and a resistance force formula was derived for the case of weak fields ($M \gg 1$). In this work a solution is given for strong fields ($M \gg 1$). (R.V.J.)

26121

IRON-CLAD MAGNETIC CYLINDRICAL LENS WITH THE ANTISYMMETRY SPACE. S. Ya. Yavor and M. Silad'i (Leningrad Inst. of Physics and Tech.). *Zhur. Tekh. Fiz.* 30, 927-32(1960) Aug. (In Russian)

The focusing and deflecting properties of certain cylindrical iron-clad magnetic lenses with plane anti-symmetry are investigated, and their fields are measured and calculated. The positions of linear images produced are found. (tr-auth)

26122

A MAGNETIC SYSTEM WITH NON-HOMOGENEOUS FIELD FOR EXPERIMENTAL INVESTIGATION OF ELECTRON TUBES. A. Ya. Sochnev. *Zhur. Tekh. Fiz.* 30, 933-7(1960) Aug. (In Russian)

Evaluations were made of the maximum heterogeneity of fields produced by an ordinary two-pole system, and a method is suggested for theoretically plotting new magnetic systems with field intensities at the axis of interplanar space which vary according to an assigned law. The configuration of a magnetic system that produces a field with parabolic intensity variations was determined, and it is shown that the field heterogeneity can be considerably higher than that of an ordinary two-pole system. (R.V.J.)

26123

THE INVESTIGATION OF CONTROLLED TRIGGERED SPARK-GAP. P. I. Shkuropat. *Zhur. Tekh. Fiz.* 30, 954-63(1960) Aug. (In Russian)

The time delay of triggered spark discharge in air at atmospheric pressure is studied. The results of tests are used for developing a mechanism for discharge in spark gaps. A controlled spark-gap design is suggested which has a small time delay. (tr-auth)

26124

THE DISTRIBUTION OF POTENTIAL IN LAYER OF VOLUME CHARGE OF POSITIVE IONS. V. A. Ivanchenko and L. A. Sena (Direct Current Research Inst., Leningrad). *Zhur. Tekh. Fiz.* 30, 964-70(1960) Aug. (In Russian)

The distribution of potential in the positive charge layer was determined by a method based on an analysis of the energies of ions passing through the layer. The method was tested in a discharge-plasma layer formed between negative electrodes in mercury vapor. The results were correlated with data calculated by the Langmuir formula and with optical measurements of the layer thickness. The measured thickness of the layer is about 20% higher than calculated optically determined thicknesses. The discrepancy is due to a systematic error in determining the recharge range. (R.V.J.)

26125

REPORTS ON PROGRESS IN PHYSICS. VOLUME XXIII. A. C. Stickland, ed. London, The Physical Society, 1960. 632p.

Information is presented on the following: optical properties of thin films, group theory in solid state physics, photoelectric photometry, electronic structure of metals, interference spectroscopy, planetary nebulae, band structure in solids, orbital electron capture by nuclei, precision measurements in γ -ray spectroscopy, and He^3 induced reactions. Separate abstracts were prepared for the final three papers. (B.O.G.)

26126

ASPECTS OF ABSTRACT FIELD THEORY. M. Dresden

(Northwestern Univ., Evanston, Ill.). p.366-434 of "Lectures in Theoretical Physics. Volume II." Wesley E. Brittin and B. W. Downs, eds. New York, Interscience Publishers, Inc., 1960.

In current theoretical discussions of fundamental particle physics, high energy physics, and quantum electrodynamics, the abstract formulation of field theory plays a significant role. There are many versions of this abstract or axiomatic formulation. In this discussion, no attempt is made to give a comprehensive coverage of the field; rather, certain special aspects are discussed in detail, while others are omitted. The guiding idea throughout the presentation was to illuminate the need for the use of sophisticated mathematical techniques in physical problems. The general purpose of the lectures is to provide, for those familiar with the basic ideas of quantum electrodynamics, a way to become acquainted with a few of the methods and results of some of the abstract versions of field theory. The discussion is divided into six parts: lessons from quantum electrodynamics, asymptotic formulation of field theory, the S matrix and the reduction formulas, derivation of the Low equations, dispersion relations for forward scattering, and comments concerning Wightman's approach to the axiomatic formulation of relativistic quantum field theory. (B.O.G.)

26127

METHOD OF AND APPARATUS FOR CONTINUOUSLY FOLLOWING STRUCTURAL CHANGES OF MATTER WITH THE AID OF X-RAYS, GAMMA RAYS OR CORPUSCULAR RAYS. (to Deutsche Gold und Silber Scheideanstalt Vormalis Roessler). British Patent 843,284. Aug. 4, 1960.

An x-ray diffraction apparatus is described for continuously studying structural changes in matter, based on moving the film at right angles to the diffracted radiation. It is an improved version of a prototype which interposed a slit between the sample and film in that the radiation is allowed to fall unhindered on the film, thus reducing the required exposure times. The film is moved at a speed adapted to the intensity of the diffracted radiation, and timing marks indicate the speed used. It is true that the innermost and outermost lines show some blur, called vanes, but they do not interfere with the interpretation of the pattern. The apparatus is comprised of cylindrical housing surrounded by cooling devices; the sample is heated inside the housing, and the film, cooled by the cooling devices, passes over a collimator located above the sample. The apparatus can be adapted for use with γ rays and electron beams, but a vacuum is necessary. (D.L.C.)

26128

ION SOURCE. (to U. S. Atomic Energy Commission). British Patent 843,648. Aug. 4, 1960.

An improved ion source is described which provides intense ion beams with minimum molecule egress from the source; it comprises an ionization chamber in which an annular anode is positioned between a filament and an electrode, the latter of a relatively small surface area. Electron oscillation or refluxing is employed to provide elongated electron paths for increased ionization. An arc plasma is produced by electron discharge in a gaseous atmosphere to provide a large ion reservoir. Since ion and electron bombardment produces heat, the anode is cooled by fins. (D.L.C.)

Astrophysics and Cosmology

26129

STUDIES OF IONOSPHERE AND INTERPLANETARY GAS

BY MEANS OF ARTIFICIAL SATELLITES AND COSMIC ROCKETS. Ya. L. Alpert. *Uspekhi Fiz. Nauk* 71, 369-409(1960) July. (In Russian)

A review is given of various radio methods in investigating the electromagnetic properties of the ionosphere and interplanetary gas (at 300 to 400 km) by means of artificial satellites and cosmic rockets. Special attention is paid to interactions of moving bodies with plasma. An account is given of the data on the electromagnetic properties of the media (the density of charged particles, elastic interactions between particles, electron and ion heterogeneous formations, plasma waves, electromagnetic particle emission, etc.) 49 references. (R.V.J.)

Cosmic Radiation

26130 LAMS-2445(p.157-62)

Los Alamos Scientific Lab., N. Mex.

RADIATION DOSE RATES ABOVE THE ATMOSPHERE.

M. A. Van Dilla, J. H. Larkins, et al.

An ion chamber was developed for dose-rate measurements in space. It was anticipated that the chamber would be used to measure biological dose rates in the Van Allen radiation belts at an expected altitude of 2000 miles or for use in a recoverable capsule from a vehicle in polar orbit at about 200 miles altitude. Use in Discoverer and Journeyman satellites during 1960 was expected. Construction details of the chamber and electronics are shown in a schematic sketch. (C.H.)

26131 NP-9167

India. Dept. of Atomic Energy. Cosmic Ray Research Committee, Bombay.

PROCEEDINGS OF THE COSMIC RAY SYMPOSIUM, 1959, BOMBAY, MARCH 9-12, 1959. R. R. Daniel, M. G. K. Menon, and B. V. Sreekantan, eds. 307p.

Thirty-eight papers are included; separate abstracts have been prepared for thirty-four. Four papers were previously abstracted in *NSA*. (M.C.G.)

26132 NP-9167(p.1-17)

Tata Inst. of Fundamental Research, Bombay.

THE PRIMARY COSMIC RADIATION. (REVIEW).

S. Biswas.

The present state of information on primary cosmic radiation is reviewed. Recent advances in experimental techniques, geomagnetic effects on the distribution of cosmic radiation, composition and intensity of primary radiation, and the energy spectrum of the different components are discussed. (M.C.G.)

26133 NP-9167(p.18-26)

Tata Inst. of Fundamental Research, Bombay.

SUPER NOVA ORIGIN OF COSMIC RAYS. (REVIEW).

R. R. Daniel.

The theory of the super nova origin of cosmic rays was developed to explain many of the important characteristics of primary cosmic radiation. These characteristics include average intensity, chemical composition, energy spectrum, directional symmetry, and almost complete absence of primary electrons. It is shown that the crab nebula can act as a source and accelerating mechanism for cosmic rays. The over-all production rate of cosmic rays was calculated to be 10^{41} particles/sec and the super novae production rate was calculated as 3×10^{40} particles/sec. The energy and chemical composition of the cosmic radiation are compared with particle production and energy generation in the crab nebula. (M.C.G.)

26134 NP-9167(p.27-33)

Tata Inst. of Fundamental Research, Bombay.

THE FLUX, ENERGY SPECTRUM, AND CHARGE SPECTRUM OF HEAVY NUCLEI OF $Z \geq 6$ IN THE PRIMARY COSMIC RADIATION AT GEOMAGNETIC LATITUDE $\lambda = 53^\circ$. S. Biswas, P. J. Lavakare, K. A. Neelakantan, and P. G. Shukla.

Elastic collisions between heavy nuclei from cosmic radiation and free electrons were analyzed to determine the characteristics of the heavy nuclei. An emulsion stack was exposed at 53° geomagnetic latitude at an altitude of 113,000 ft. The energy spectrum, flux, and charge spectrum were determined. The geomagnetic cut-off energy as determined by this experiment was 230 Mev per nucleon compared to 400 Mev predicted by theory. (M.C.G.)

26135 NP-9167(p.34-41)

Physical Research Lab., Ahmedabad, India.

TIME VARIATIONS OF COSMIC RAYS. (REVIEW). R. P. Kane.

Studies revealed that the daily mean intensity of cosmic rays showed variations that had an 11-year cycle and a 27-day recurrence tendency. Analysis showed that the daily variations could be classified into three types: variations where the curves were predominantly single humped and had an hour of maximum during the day, variations where the curves were again single humped but with the maximum at night, and variations where the curve was essentially double humped, showing 2 maxima and 2 minima in 24 hr. (M.C.G.)

26136 NP-9167(p.42-4)

Physical Research Lab., Ahmedabad, India.

COMPARATIVE STUDY OF COSMIC RAY INTENSITY AT AHMEDABAD, KODAIKANAL AND TRIVANDRUM. S. P. Duggal.

Measurements of cosmic-ray intensity were made at three stations in India from 1955 to 1957 with triple-coincidence verticle-counter telescopes. A plot of yearly diurnal variation at these stations showed that in 1956 the amplitude of diurnal variation at Trivandrum was much higher than that of Ahmedabad or Kodaikanal. The Ahmedabad and Trivandrum curves differed significantly in 1955 and 1956 but were very similar both in amplitude and phase in 1957. (M.C.G.)

26137 NP-9167(p.45-58)

Physical Research Lab., Ahmedabad, India.

COMPARATIVE STUDY OF COSMIC RAY DAILY VARIATION IN EAST AND WEST AT AHMEDABAD. U. R. Rao.

An east-west instrument, consisting of narrow-angle telescopes with different openings in the east-west plane and inclined to the zenith at 45°E and 45°W , was put into operation in January 1957, at Ahmedabad, India, where the east-west asymmetry of cosmic radiation was about 15%. Results showed that the amplitude of variation in the east was at least twice that in the west. The hour of maximum in the east occurred 3 to 4 hr earlier than in the west. There were only slight changes in the form of daily variations in 1957 and 1958. (M.C.G.)

26138 NP-9167(p.59-60)

Physical Research Lab., Ahmedabad, India.

LONG TERM CHANGES OF THE DAILY VARIATION OF COSMIC RAYS. T. S. G. Sastry.

The daily variation of meson intensity was measured at Kodaikanal, India, from 1954 to 1956. The major changes in daily variation were due to the decrease in amplitude of the diurnal component on individual days (with a maximum shortly after midnight), accompanied by a rapid decrease in

the frequency of occurrence of such days. The average daily variation was also affected by geomagnetic disturbances. (M.C.G.)

26139 NP-9167(p.61-3)

Tata Inst. of Fundamental Research, Bombay.

TIME VARIATION STUDIES OF COSMIC RAY INTENSITY AT BALLOON ALTITUDES. V. K. Balasubramanian and K. N. Choudhuri.

Short-term intensity variations in cosmic radiation were detected and measured at balloon altitudes using a high counting rate Geiger-Mueller counter telescope. Whenever a count occurred a modulator set off a 73-Mc transmitter and the count was recorded on the ground by continuously photographing an oscilloscope. The counting rate at 15 mb, as observed on a recent plastic balloon flight, was 2.2×10^5 counts per hour and an intensity variation of 0.6% per hour could have easily been detected. (M.C.G.)

26140 NP-9167(p.112-15)

Massachusetts Inst. of Tech., Cambridge.

LIFETIME SPECTRUM MEASUREMENTS IN THE COSMIC RAY BEAM IN A SEARCH FOR THE $\sim 550m_e$ PARTICLE. E. Boldt, J. Hersil, Yash Pal, and J. Russel.

The lifetime spectrum of cosmic rays was measured in a search for the existence of $550m_e$ particles. Experiments were carried out to detect the two possible decay modes: $550m_e \rightarrow \text{light meson} + Q + ?$ or $550m_e \rightarrow \pi^0$ and/or γ and/or $e^+ + Q$. The relative abundance with respect to μ mesons of the particles with lifetimes greater than one millisecond was found to be in the range from 0.15 to 0.6%. (M.C.G.)

26141 NP-9167(p.116-22)

Bose [Research] Inst., Calcutta.

LOW ENERGY SPECTRUM OF SEA LEVEL ELECTRONS AND MUONS AT 12°N. Nilima Basu and M. S. Sinha.

A multiplate cloud chamber triggered by a three-fold coincidence system was used to study the low-energy spectrum of sea level electrons and μ mesons. The differential energy distribution of electrons within the energy interval 5 to 300 Mev and the fine structure of the differential range spectrum of μ mesons within the range interval 6.0 to 60.0 g/cm² of air equivalent were determined. The total vertical intensity of electrons in the energy range between 5 and 310 Mev was found to be $1.43(\pm 0.21) \times 10^{-3}$ /cm²-sec-sterad. Intensities of μ mesons and electrons are given as a function of kinetic energy. (M.C.G.)

26142 NP-9167(p.123-9)

Physical Research Lab., Ahmedabad, India.

EXTENSIVE AIR SHOWERS. (REVIEW). N. W. Nerurkar.

Extensive air showers are initiated by primary cosmic rays of very high energies which, in the case of the proton, range from 10^{14} to 10^{17} ev. Developments in detectors made it possible to study the difference in the times of arrival of particles in air showers in addition to their number and density. Theoretical estimates of the lateral distribution of charged particles in the air showers are discussed. Results of an air shower experiment which show a possible anomalous behavior of the nucleon component are given. It was found that particles occasionally arrived that were delayed with respect to the shower front. The amount of delay was dependent on the nature of the particle and also on height of production and energy at production. (M.C.G.)

26143 NP-9167(p.130-2)

Physical Research Lab., Ahmedabad, India and Massachusetts Inst. of Tech., Cambridge.

AIR SHOWER EXPERIMENT AT KODAIKANAL. E. V. Chitnis and G. W. Clark.

To determine the directional distribution of high-energy primary cosmic particles, an air shower experiment was conducted at Kodaikanal, India. A total of 100,000 events was recorded, and 36,000 of these were analyzed. Initial energies were computed and found to be between 10^{14} and 10^{15} ev. A method of grouping showers into narrower energy bands, in order to determine the arrival direction in well-defined energy ranges, is discussed. (M.C.G.)

26144 NP-9167(p.133-41)

Tata Inst. of Fundamental Research, Bombay.

HIGH ENERGY INTERACTIONS AND EXTENSIVE AIR SHOWERS (TATA INSTITUTE OF FUNDAMENTAL RESEARCH EXPERIMENTS). B. V. Sreekantan.

Studies of high-energy interactions and extensive air showers gave definite evidence for the presence of high-energy nuclear-active particles at mountain altitudes and at sea level. There were multiple nuclear-active particles of comparable energy, and the multiplicity increased with the shower size. The spectrum of nuclear-active particles was parallel to the primary spectrum. There was a sudden change in the slope of the total nuclear-active component at an energy of about 2×10^{15} ev. Fluctuations in air showers and their causes were studied. (M.C.G.)

26145 NP-9167(p.142-7)

Tata Inst. of Fundamental Research, Bombay.

AN EXPERIMENTAL STUDY OF THE FLUCTUATIONS IN THE NUCLEAR-ACTIVE COMPONENT OF EXTENSIVE AIR SHOWERS. B. K. Chatterjee, G. T. Murthy, S. Narana M. V. Sreenivasa Rao, and B. V. Sreekantan.

An experiment was developed to determine the fluctuations in the number of nuclear-active particles and μ mesons in air showers. Six liquid scintillators were used to record electron density for calculating shower size and core position. Six detectors of nuclear-active particles and neutron detectors consisting of enriched BF₃ embedded in paraffin and lead were used. A scintillation detector and Geiger counter tray were used to select the air showers. A double coincidence between them provided the master pulse for recording the density data. (M.C.G.)

26146 NP-9167(p.148-56)

Tata Inst. of Fundamental Research, Bombay.

CLOUD CHAMBER EVIDENCE FOR THE PRESENCE OF SIMULTANEOUS HIGH ENERGY NUCLEAR-ACTIVE PARTICLES AT MOUNTAIN ALTITUDES. P. V. Ramana-murthy, S. Narana, R. Raghavan, A. Subramanian, and B. V. Sreekantan.

A multiplate cloud chamber was used to obtain evidence of the presence of nuclear-active particles at mountain altitudes. Cases of two parallel nuclear-active particles of high energy interacting either in lead above the chamber or in the plates inside were observed. In 75% of the cases, the double-core events were associated with air showers. The details of 32 cases are given. For interpreting the results, the following possibilities were considered: the higher energy core was produced by a nucleon and the smaller core by a pion, both cores produced by nucleons or both cores produced by pions. (M.C.G.)

26147 NP-9167(p.163-5)

D. S. B. Government Coll., Nainital, India.

PROGRESS OF EXTENSIVE AIR SHOWER PROJECT AT NAINITAL. B. N. Srivatsava.

An air shower project at Nainital was designed to study the time variations of extensive air showers with solar and sidereal time and the anisotropy in the primaries of these showers. The nature of variations of hourly average value in solar time is shown. Three Geiger-Mueller trays,

placed at a distance of 8m on a triangular lattice, were used. The rate of showers recorded by this system was of the order of 8 per hr. (M.C.G.)

26148 NP-9167(p.217-21)

Jadavpur Univ., Calcutta and Bose [Research] Inst., Calcutta.

ESTIMATION OF THE ENERGIES OF NUCLEAR INTERACTING PRIMARY PARTICLES FROM THE DISTRIBUTION OF THE PROJECTED ANGLES OF THEIR SECONDARIES IN A MULTIPLATE CLOUD CHAMBER. N. C. Das and M. S. Sinha.

The average energy of primary particles that produce showers can be estimated from the angular distributions of the penetrating secondary particles in the shower. Since the measurement of the actual space angles from the stereo-reprojection of the pictures was a long process a distribution formula was developed in terms of the projected angles which were easily measured from photographic negatives. (M.C.G.)

26149 NP-9167(p.232-5)

Madras. Univ.

POLARISATION IN CASCADES. R. Vasudevan.

A cascade started by a longitudinally polarized particle was examined to determine whether this longitudinal polarization was inherited through later shower development. Angular integrations of the diffusion equations for density matrices gave four uncoupled equations for transverse polarization, two coupled equations for longitudinal polarization and two coupled equations for total polarization. The process was also investigated from the point of view of the cascade theory developed by Ramakrishnan and Srinivasan. (M.C.G.)

26150 NP-9167(p.236-40)

Tata Inst. of Fundamental Research, Bombay.

AN EXPERIMENT TO STUDY THE INTERACTIONS OF NUCLEAR ACTIVE PARTICLES OF ABOUT 50 Bev. Siddeswar Lal, Yash Pal, and R. Raghavan.

An experiment was set up to detect and estimate the energies of nuclear-active particles in the region 20 to 100 bev and to study the interaction characteristics at these energies. The experimental equipment includes a producer which is a 4-in.-thick graphite block, two brass plates, and two Geiger trays and a liquid scintillator which act as a trigger. (M.C.G.)

26151 JPRS-5440

EXPERIENCE IN MEASURING CORPUSCULAR RADIATION IN THE UPPER ATMOSPHERE. (Opyt Izmereniya Korpuskulyarnovo Izlucheniya v Verkhney Atmosfere). L. A. Antonova and G. S. Ivanov-Kholodnyi. Translated from *Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz.* No. 5, 756-7(1960). 6p. OTS.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 14, as abstract No. 19678.

26152 NASA-TT-F-39

DISCOVERY OF ELECTRONS WITH AN ENERGY OF ABOUT 10 KEV IN THE UPPER ATMOSPHERE WITH THE AID OF THE THIRD EARTH SATELLITE. V. I. Krasovskii (Krasovskiy), I. S. Shklovskii (Shklovskiy), Yu. I. Gal'perin, and E. (Ye.) M. Svetlitskii (Svetlitskiy). Translated from *Doklady Akad. Nauk S.S.S.R.* 127, 78-81(1959). 8p. OTS.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 14, as abstract No. 2861.

26153

ON THE DETECTION OF COSMIC RAY AIR SHOWERS BY

MICROWAVE TECHNIQUES. I. Segal (Technion-Israel Inst. of Tech., Haifa). *Bull. Research Council Israel. Sect. F.* 9, 17-30(1960) June. (In English)

The amount of energy radiated from a shower in the form of Cherenkov radiation and bremsstrahlung was calculated. The expressions used are based on approximation B of the shower theory taking into account the contributions of successive generations. The calculations show that in the region $\nu = 10^{10}$ cps bremsstrahlung exceeds Cherenkov radiation by approximately an order of magnitude, and showers of energy greater than 10^{17} ev should be detected by sensitive microwave techniques. (auth)

26154

ON THE ELECTRONIC COMPONENT OF EXTENSIVE AIR SHOWERS NEAR THE AXIS. Tadashi Kameda, Yoshio Toyoda, and Toshio Maeda (Kobe Univ., Japan). *J. Phys. Soc. Japan* 15, 1585-74(1960) Sept. (In English)

Using two multiplate cloud chambers and five density detectors consisting of 250 G-M counter hodoscopes, characters of the electronic component of extensive air showers were investigated for various distances from the axis in the range $r \leq 10$ m at 2770 m altitude. The size N of the selected showers extended from 1×10^5 to 2×10^6 . The integral size spectrum can be represented by a power law of the form $N^{-\gamma}$, where the value of γ varies from 1.5 to 2.0 as the size increases. The lateral density distribution of the high-energy electronic component with the energy $E \geq 1$ bev fits well to that of the pure electronic shower with the age parameter $s = 1.4$. The ratio of the density of high-energy electrons and photons to that of all electrons is independent of the atmospheric depth. The integral energy spectrum can be expressed by the E^{-n} within the energy region $250 \text{ Mev} \leq E \leq 1 \text{ bev}$, and the value of n shifts from 0.7 to 1.2 with increasing r . The lateral distribution of the energy flux carried by the electronic component is expressed by the form $r^{-(1.57 \pm 0.24)}$. The showers having steeper lateral distribution of electrons than the average one near the axis contain more high-energy rays. The average zenith angle distribution is represented by the form $\cos^{6.7 \pm 1.4} \theta$; however, the distribution of showers containing more high-energy rays is represented by the form $\cos^{10.0 \pm 2.0} \theta$. (auth)

26155

DEPENDENCE ON LATITUDE OF THE AMPLITUDE OF THE DIURNAL VARIATION OF COSMIC RAYS. Arne Eld Sandström, Eric Dyring, and Stig Lindgren (Univ. of Uppsala). *Nature* 187, 1099-1100(1960) Sept. 24.

Variations of cosmic-ray intensity were recorded with inclined counter telescopes at Uppsala, Kiruna, and Murchison Bay, Spitsbergen. The telescopes at Uppsala and Murchison Bay pointed in the east and west directions. Those in Kiruna pointed north and south. Results showed that the amplitude of the diurnal variation decreases with increasing angle between the asymptotic direction of the primaries and the equatorial plane of the earth. (M.C.G.)

26156

METEOROLOGICAL COEFFICIENTS AND SOLAR DAILY VARIATION OF THE COSMIC RADIATION MEASURED UNDERGROUND. T. Sándor, A. Somogyi, and F. Telbisz (Central Research Inst. of Physics, Budapest). *Nuovo cimento* (10) 17, 1-7(1960) July 1. (In English)

The intensity of the penetrating component of cosmic radiation was registered since Feb. 20, 1958. The absorption and decay coefficients, as well as the total barometric coefficient, were determined from the data of the first year of the observation. The amplitude of the fluctuation of the

primary radiation was also determined for each month, as well as the amplitude of the solar daily variation. (auth)

26157

COSMIC RAY INTENSITY INCREASE ON MAY 4, 1960.

O. R. Santochi, J. R. Manzano, and J. G. Roederer (Comision Nacional de Energia Atómica, Buenos Aires). *Nuovo cimento* (10) **17**, 119-21(1960) July 1. (In English)

On May 4, 1960, a sudden large increase in cosmic-ray intensity of about 110% was detected. After the initial peak, the intensity dropped to the previous level after about two hours. A graph of the 15-min counting rate percentage intensity variation and an integrated counting rate graph are given. (M.C.G.)

26158

ON THE MOMENTUM SPECTRUM OF PARTICLES IN COSMIC RAY JETS. J. Pernegr, V. Šimák, and M. Votruba (Inst. of Physics, Czechoslovak Academy of Sciences, Prague). *Nuovo cimento* (10) **17**, 129-33(1960) July 16. (In English)

It is shown that the form of momentum spectrum of jet particles is essentially dependent on the degree of anisotropy of the angular distribution, and that, for example, the form dp/p^2 corresponds to a definite anisotropy. Integral spectra of directly measured values of p indicated a systematic decrease of transversal momenta in the vicinity of the axis and of the $\pi/2$ -plane in C.M. system. (auth)

25159

AN EXPERIMENT ON NUCLEAR INTERACTIONS OF HIGH ENERGY ($10 + 100$ GeV). E. R. T. Awunor-Renner, L. Blaskovitch, B. R. French, C. Ghesquière, I. B. de Minville-Devaux, W. W. Neale, C. Pelletier, P. Rivet, A. B. Sahiar, and I. O. Skillicorn (Imperial Coll., London and Ecole Polytechnique, Paris). *Nuovo cimento* (10) **17**, 134-65(1960) July 16. (In English)

Interactions of cosmic-ray particles with aluminum nuclei were studied. One hundred and one showers containing no apparent unstable particles yielded the following multiplicities: $n_2 = 7.3$; $n_3^+ = 3.9$; $n_2^- = 2.7$; $n_3^+ = 0.6$. The momentum and angular distributions of the secondary particles were examined, and an attempt was made to study the momentum-angle correlation. The mean transverse momentum was 0.31 BeV/c, the rms deviation about this mean being 0.23 BeV/c. A quantity related to the $(U - p_L)$ of the recoil nucleon was also investigated. Twelve showers containing one V^0 each and one shower containing two V^0 particles were studied; this showed that the 117 showers contained: $29.5_{-11.0}^{+14.0} \Lambda^0$ and $18.0_{-10.0}^{+15.0} \theta^0$ particles. Three showers containing V^\pm particles were also studied; one of them was probably a Ξ^- particle. (auth)

26160

A CLOUD CHAMBER STUDY OF NUCLEAR INTERACTIONS WITH ENERGIES OF ABOUT 100 GeV. L. Montanet, J. A. Newth, G. Petrucci, R. A. Salmeron, and A. Zichichi (European Organization for Nuclear Research, Geneva). *Nuovo cimento* (10) **17**, 166-88(1960) July 16. (In English)

A cosmic-ray experiment to study 100-BeV nuclear interactions with a magnet cloud chamber is reported. The analysis of the interactions is described and the hypotheses necessary for interpreting the measurements are discussed. Results from a first sample of 41 interactions are given. They show that the transverse momenta of the secondary particles are generally low (< 0.5 BeV/c) and that in the center of momentum frame of reference the emitted particles mostly have low momenta and their angular distribution is anisotropic. There is also some evidence that

in a nucleon-nuclear interaction at these energies the number of nucleons involved is small. The proportion of strange particles among the secondaries is similar to that found in interactions of much lower energy. (auth)

26161

HYDRODYNAMIC ORIGIN OF COSMIC RAYS. Stirling A. Colgate (Univ. of California, Livermore), and Montgomery H. Johnson. *Phys. Rev. Letters* **5**, 235-8(1960) Sept. 15.

The mechanism of supernova explosions, the hydrodynamic motion following the explosion, the subsequent flow of radiation, and the structure of relativistic shock fronts were studied to prove that the material spalled from the surface of the supernova is the source of cosmic radiation. Astronomical evidence indicated that approximately one tenth of the mass is ejected in a supernova explosion. The final kinetic energy of the expanded material gave directly the energy distribution of cosmic radiation. The absolute intensity of cosmic radiation was estimated from the frequency of supernova explosions, about one per 100 years. The distribution of elements in cosmic radiation agreed well with that expected in the outermost parts of the supernova star. It was found that shock structure could be modified by plasma oscillations. (M.C.G.)

26162

RAPID REDUCTION OF COSMIC-RADIATION INTENSITY MEASURED IN INTERPLANETARY SPACE. C. Y. Fan, Peter Meyer, and J. A. Simpson (Univ. of Chicago). *Phys. Rev. Letters* **5**, 269-71(1960) Sept. 15.

Results of studies of variation in cosmic-ray intensity at the earth and at the position of Pioneer V in interplanetary space proved that the rapid reduction in galactic cosmic radiation is a phenomenon of solar origin, taking place in interplanetary space, and is not related to the presence of the earth or its magnetic field. Since the observed intensity decreases only follow solar flares on the visible side of the sun, the reduction of cosmic-particle intensity is confined to a limited volume of the inner solar system. Properties of the modulating magnetic fields were also determined. (M.C.G.)

26163

EXPERIMENTS ON THE ELEVEN-YEAR CHANGES OF COSMIC-RAY INTENSITY USING A SPACE PROBE. C. Y. Fan, Peter Meyer, and J. A. Simpson (Univ. of Chicago). *Phys. Rev. Letters* **5**, 272-4(1960) Sept. 15.

Experiments in which cosmic radiation detectors were carried into space by Explorer VI and Pioneer V proved that any mechanism changing the cosmic-ray intensity over 11 years is centered about the sun. The scale size is > 1 astronomical unit for the volume of space in which the cosmic-ray intensity is reduced at this period of the solar activity cycle. Cosmic-ray flux was approximately constant from inside the terrestrial field far into the interplanetary medium. Therefore the 11-year depression of cosmic-ray intensity is not geocentric. A radial omnidirectional intensity gradient of $-(15 \pm 20)\%/A$ was measured near the orbit of the earth and in the direction of the sun. This gradient showed that any electromagnetic-modulating mechanism required to account for the 11-year intensity variation is located principally outside the orbit of the earth. (M.C.G.)

26164

LATITUDE AND ALTITUDE DISTRIBUTION OF GEOMAGNETICALLY TRAPPED PROTONS. S. F. Singer (Univ. of Maryland, College Park). *Phys. Rev. Letters* **5**, 300-3(1960) Oct. 1.

An extension of earlier work on the nature and proper-

ties of radiation belt particles is presented. A theory is derived for the geometrical injection coefficient, and its use in calculating the latitude and altitude dependence is shown. This extension is based purely on geometry and involves only the additional fact that in the decay of the fast neutron, the resulting proton preserves its direction. The theory was used to calculate the omnidirectional integral intensity of trapped protons in the plane of the magnetic equator at an altitude of 1 and 2 earth radii, and the omnidirectional proton flux in the same plane. The results of the calculations are shown graphically. (B.O.G.)

26165

THE ONSET TIMES OF COSMIC-RAY STORMS. Kazuaki Murakami and Shoko Kudo. *Sci. Papers Inst. Phys. Chem. Research (Tokyo)* **54**, 155-61 (1960) June. (In English)

The onset times of cosmic-ray storms were investigated with reference to various detectors located at different places over the world. When a sudden decrease occurs within a few hours before or after sudden commencement of the geomagnetic storm, the local time and energy dependencies are convincible. The local time dependency shows that the onsets are generally seen earlier on the detectors in the morning than at other times when the storms occur although this earlier zone is not always fixed but fluctuates. For the energy dependency, the lower energy particles show a decrease earlier than the higher energy ones. It is concluded from these dependencies that a diffusion model is most probable for the cosmic-ray storm, at least in the initial stage. (auth)

26166

A LARGE COSMIC-RAY METER AND COSMIC-RAY SHORT PERIOD FLUCTUATIONS. Kazuo Torizuka (Tokyo Gakugei Univ.) and Masami Wada. *Sci. Papers Inst. Phys. Chem. Research (Tokyo)* **54**, 162-9 (1960) June. (In English)

A large cosmic-ray meter with an accuracy of 0.3% for a 1 min counting rate was constructed by using the particle density detector of the air shower apparatus at the Institute for Nuclear Study in Tokyo. One of the main interests of operating such highly sensitive apparatus is to investigate the short period fluctuation of cosmic-ray intensity, the time scale being in the order of a few to a few tens of minutes. An analysis of data obtained in April and May 1959 showed the amplitude of short period fluctuation varied diurnally with a maximum in the daytime and the fluctuations varied also from day to day; these showed a positive correlation with mean cosmic-ray intensity. No coherent periodic short-time fluctuations were found. (auth)

26167

THE DATA ON THE ORIGIN OF COSMIC RAYS. V. L. Ginzburg and S. I. Syrovatskiĭ. *Uspekhi Fiz. Nauk* **71**, 411-69 (1960) July. (In Russian)

A general analysis and evaluation are made of data, presented at the International Conference on Cosmic Radiation in Moscow, July 1959, on the origin of cosmic rays. Basic and new data on primary cosmic radiation, on the life-time and motion of cosmic rays, on cosmic ray sources and the mechanism of their acceleration, and on the transformation of nuclear component in cosmic radiation are discussed. 144 references. (R.V.J.)

Criticality Studies

26168 CF-60-4-12

Oak Ridge National Lab., Tenn.

CRITICAL EXPERIMENTS FOR REACTOR PHYSICS

STUDIES. R. Gwin and D. W. Magnuson. Sept. 16, 1960. 64p. OTS.

The thermal value of $\bar{\eta}$ for U^{233} and U^{235} was determined in a series of experiments involving direct comparison of the critical parameters of unreflected homogeneous aqueous solutions of the two isotopes. Auxiliary experiments establishing limits of error, testing certain aspects of the theoretical model employed, and experimentally determining the parameters in the critical equation were performed. Experiments performed with 27-in.-diameter and 48-in.-diameter spheres and 5-ft-diameter and 9-ft-diameter cylinders yielded consistent values of η . Measurements of the nonleakage probability in cylindrical geometry gave values consistent with those predicted by a two-group model in which the theoretical value of the age was used. Within the experimental error no differences were found in the ages of fission neutrons for U^{233} and U^{235} . The average thermal values of η determined are $\bar{\eta}$ for U^{233} , 2.284 ± 0.015 and $\bar{\eta}$ for U^{235} , 2.074 ± 0.015 . The 2200 m/sec values are the same since the g-factors for η are unity. (auth)

Elementary Particles and Radiations

26169 AERE-R-3369

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

APPROXIMATE SOLUTION OF THE ONE VELOCITY NEUTRON TRANSPORT EQUATION IN AN INFINITE MEDIUM. G. Rowlands. Aug. 1960. 30p. BIS.

A simple, though approximate, solution of the one-velocity neutron-transport equation in an infinite medium is obtained. Numerical values of the total flux obtained using this approximation compare very favorably with the exact values. (auth)

26170 AFCRC-TR-60-113

Air Force Cambridge Research Center. Propagation Sciences Lab., Bedford, Mass.

APPROXIMATE VALUES OF THE RADIATION HARMONICS FROM RELATIVISTIC CHARGES IN UNIFORM CIRCULAR MOTION. E. A. Lewis. July 21, 1959. 51p. Project No. 4662. (AD-234554). OTS.

Graphs and tables are presented of approximate numerical values of the known expressions for the harmonic components in the radiation fields of a relativistic charge in uniform circular motion. These expressions contain Bessel functions of large order and large argument, evaluated by means of asymptotic and special interpolation formulas. (auth)

26171 CERN-60-32

European Organization for Nuclear Research, Geneva. NOTE ON THE CALCULATION OF DEUTERON PRODUCTION IN HIGH ENERGY EVENTS. L. I. Schiff. Aug. 23, 1960. 8p.

Additional justification is provided for the procedure employed by R. Hagedorn in calculating deuteron production in high-energy events. (W.D.M.)

26172 HW-66331

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

SUMMARY OF SCATTERING LAW MEASUREMENTS AT HANFORD LABORATORIES—AUGUST 1, 1960. B. R. Leonard, Jr. Aug. 4, 1960. 6p. Contract AT(45-1)-1350. OTS.

Scattering law measurements were performed using crystal diffraction spectrometers to obtain the incident

monoenergetic neutrons and to measure the energy of the scattered neutrons. The measurements were taken on water. (C.J.G.)

26173 KAPL-M-GJH-4

Knolls Atomic Power Lab., Schenectady, N. Y.
CLOSURE PROPERTIES ON OSCILLATION MATRICES
WITH APPLICATIONS. G. J. Habetler and E. P. Shelly.
Aug. 3, 1960. 15p. Contract W-31-109-Eng-52. OTS.

It is shown that the product of an oscillation matrix, with either an oscillation matrix or a positive diagonal matrix, is again an oscillation matrix. In the application of this result to the one-space-dimension few-group neutron diffusion equation in which fission occurring in the last group only is a limiting factor, it follows that its usual finite difference representation possesses positive and distinct eigenvalues. (auth)

26174 NP-9105

Maryland. Univ., College Park.
K⁻-MESON CAPTURE BY HELIUM. Technical Report No. 183. T. B. Day. July 1960. 26p. Contract AF49(638)-24. (AFOSR-TN-60-819).

Some atomic and molecular processes which occur when K⁻-mesons stop and are captured in liquid helium are investigated. It is shown that while the K⁻-meson is in its initially highly excited atomic states, S-state capture is predominant. (auth)

26175 NP-9167(p.64-71)

Madras. Univ.
WEAK INTERACTIONS. Alladi Ramakrishnan.

Weak interactions cause the decay of all elementary particles. They are classified into two groups, one involves neutrinos and the other does not. It was found that despite the different lifetimes of the particles, the weak interactions had remarkably the same coupling constant. It was determined experimentally that all weak interactions violated conservation of parity and invariance under charge conjugation. A comprehensive table listing the various observables and the associated conservation laws which were violated or obeyed by the detecting of these variables is given. (M.C.G.)

26176 NP-9167(p.72-92)

Tata Inst. of Fundamental Research, Bombay.
REVIEW OF PARTICLE PHYSICS. Yash Pal.

Some of the recent basic experiments in the field of particle physics were concerned with the electromagnetic structure of nucleons. This structure was studied by scattering high-energy electron beams off protons. In a study of the neutrino, the reverse of the reaction $\text{Ar}^{37} \rightarrow \text{Cl}^{37} + e^+ + \nu$ was attempted using $\bar{\nu}$ from a reactor. The reaction did not take place. The polarization of electrons and positrons emitted in β decay was measured and it was found that the electrons had a left-hand polarization and the positrons a right-hand. The isotopic spin and strangeness assignments of strange particles and some of their properties are given. The mass, spin, mean life, and decay scheme of each of the elementary particles are also given. (M.C.G.)

26177 NP-9167(p.93-5)

Delhi. Univ.
DECAY OF A ${}^4\text{H}$ HYPERFRAGMENT. B. Bhowmik, P. C. Jain, and P. C. Mathur.

In following the tracks of K⁻ mesons, a hyperfragment with a range of 250 μ was observed. Two tracks were observed at the point of arrest, one identified as that of a π^- meson and the other as that of an α particle. The decay, therefore, was ${}^4\text{H}_\Lambda \rightarrow \text{He}^4 + \pi^- + 55.42 \text{ Mev}$. The colline-

arity of the two tracks at the decay point and the large energy release eliminated the possibility of a Σ^- capture star. (M.C.G.)

26178 NP-9167(p.96-101)

Delhi. Univ.
ON THE LIFE TIME AND INTERACTION OF NEGATIVE K-MESONS. B. Bhowmik, P. C. Jain, and P. C. Mathur.

Emulsions were exposed to a beam of K⁻ mesons from the Berkeley Bevatron. The K⁻ tracks were followed until they came to rest, producing a capture star, interacted in flight, decayed in flight, or disappeared in flight. In 6 cases out of a total of 117 stars, there was no visible prong, blob, or auger electron at the point of arrest. Charge exchange scatterings were observed in 86 cases of interactions in flight. The interaction mean free path from 0 to 185 Mev was $21.1 \pm 2.3 \text{ cm}$. Decays in flight were observed in 13 tracks. (M.C.G.)

26179 NP-9167(p.102-6)

Tata Inst. of Fundamental Research, Bombay.
K⁺-NUCLEON SCATTERING AND THE QUESTION OF RELATIVE K⁺-Y PARITY. S. N. Biswas and L. K. Pandit.

The scattering of K⁺ mesons by nucleons and the question of relative K⁺-Y (Λ^0 , Σ hyperons) parity in these reactions were studied. The ratio of charge exchange to non-charge exchange scattering was found to be 0.2. It was found by energy dependence that the Fredholm cross section with even K⁺-Y parity was preferred. The angular dependence was consistent with both possibilities for relative parity. (M.C.G.)

26180 NP-9167(p.175-90)

Tata Inst. of Fundamental Research, Bombay.
CHARACTERISTICS OF HIGH ENERGY NUCLEAR INTERACTIONS. (REVIEW). A. Subramanian.

High-energy nucleon-nucleon and pion-nucleon collisions are discussed. General methods are given for the determination of interaction cross sections, inelasticity, multiplicity and nature of secondaries, angular and energy distributions of secondaries, and energy distribution among incident and target particles after collisions. A survey is made of results obtained by various methods. The significance of these results in relation to various theoretical ideas is also discussed. (M.C.G.)

26181 NP-9167(p.191-205)

Tata Inst. of Fundamental Research, Bombay.
PHENOMENOLOGICAL THEORIES OF MULTIPLE PRODUCTION OF MESONS IN COLLISIONS OF HIGH ENERGY NUCLEONS. (REVIEW). D. Sankaranarayana.

Several theories were developed to describe the production of mesons in the interactions of high-energy nucleons. The theories of Heisenberg, Fermi, Landau, and Bhabha are discussed and compared with experimental results. Since none of the theories were capable of explaining all the features observed in collisions, several empirical models in reasonable agreement with observed data and based on characteristic features of such interactions were developed. The model proposed by Cocconi is examined. (M.C.G.)

26182 NP-9167(p.206-10)

Tata Inst. of Fundamental Research, Bombay.
ANALYSIS OF HIGH ENERGY NUCLEAR INTERACTIONS. (REVIEW). N. Durga Prasad.

The parameters usually measured in the analysis of high-energy nuclear interactions are angular distribution and half-width of secondary particles, multiplicity and identity of secondaries, secondary energies, total energy going into meson production, primary energy, and elastic-

ity of collisions. The methods of measuring these parameters and their limitations are described. (M.C.G.)

26183 NP-9167(p.211-16)

Tata Inst. of Fundamental Research, Bombay.
CHARACTERISTICS OF N-N COLLISIONS. R. R. Daniel, N. Kameswara Rao, P. K. Malhotra, and Y. Tsuzuki.

Interactions of 6.2-bev protons in emulsions were studied for energy and angular distributions of pions and protons, inelasticity, and comparison with antiproton annihilation stars. The size of the interactions, the angular distribution of shower particles, the grain density and scattering on flat tracks, and the grain density from recoil protons were determined. The average energy of the backward proton in CMS was 622 Mev. The average value for inelasticity was 0.38 ± 0.09 . The average total energy going into pion production was 350 Mev per pion. (M.C.G.)

26184 NP-9167(p.280-90)

Tata Inst. of Fundamental Research, Bombay.
HYPERFRAGMENTS AND THE Λ -N INTERACTION. (REVIEW). M. S. Swami.

The study of Λ^0 hyperfragments gave considerable information on hyperon-nucleon interactions and on the intrinsic properties of the Λ^0 hyperon. Experimental and theoretical results are given for the binding energy of Λ^0 in nuclei with different charges, the branching ratios and angular distributions in the mesonic decay modes of light hyperfragments, the ratio of non-mesonic to π^- -mesonic decay of hyperfragments, and six anomalous events. (M.C.G.)

26185 NYO-2812

Pennsylvania. Univ., Philadelphia.
ON A METHOD OF SEARCHING FOR NEUTRAL BOSONS OR BOSON-SYSTEM RESONANCES IN THE MASS REGION OF SEVERAL M_π . W. Selove. June 6, 1960. 5p. Contract AT(30-1)-2171. OTS.

Strongly interacting bosons, or boson systems, with masses in the 3 to 4 m_π region may exist. It appears possible that the lifetime of such objects as the $T = 0$, $J = 1$ system may be of the order of 10^{-21} to 10^{-20} sec. It was proposed that the reaction $\pi^+ + n \rightarrow X^0 + p$ be the most promising method for searching for these bosons. The incoming π^+ beam should be about 770 Mev/c. (W.D.M.)

26186 RM-2556(RAND)

RAND Corp., Santa Monica, Calif.
NEUTRON FLUXES IN AIR: A COMPARISON OF MONTE CARLO CODE COMPUTATIONS BY RAND, LOS ALAMOS, AND SANDIA. J. I. Marcum. July 1, 1960. 60p. Contract AF49(638)-700.

Results are given for the solution of two neutron-transport problems in the atmosphere by means of Monte Carlo codes developed independently at RAND, Los Alamos, and Sandia. Comparisons of the results are made and the differences are discussed. It is concluded that all three codes are probably operating correctly and that such differences as exist are probably due to the different input assumptions. (auth)

26187 TID-6524

Michigan. Univ., Ann Arbor.
DIRECT PAIR PRODUCTION BY HIGH ENERGY MUONS. John F. Gaebler, Wayne E. Hazen, and Alfred Z. Hendel. Aug. 23, 1960. 20p. Sponsored by ONR and AEC under Contract Nonr-1224(07). OTS.

A multiplate cloud chamber was operated 1032 ft underground to study electromagnetic interactions of fast cosmic muons. Over 200 electron showers were observed. A histogram was obtained for transferred energies from 30 to 3000 Mev. The showers were primarily due to direct pair production and knock-on processes. (auth)

26188 UCRL-5665(p.1-11)

Argonne National Lab., Ill.
PULSED D-D NEUTRON AGE MEASUREMENTS IN GRAPHITE. (PRELIMINARY REPORT). Sait Akpinar.

Two methods are available to determine the thermal-neutron age in moderators using pulsed-neutron techniques. The feasibility of the method originally suggested by Antonov, et al., is investigated. A Model AL-102 pulsed-neutron source, BF_3 counters, and a 40-channel time analyzer were used. Measurements were made in three different cadmium-shielded geometries. (W.D.M.)

26189 UCRL-5665(p.12-28)

Oak Ridge National Lab., Tenn.
DIFFUSION PARAMETER MEASUREMENTS IN BERYLLIUM. Gerard deSausure.

An attempt was made to measure carefully the neutron-diffusion parameters of beryllium at room temperature by the method of Singwi and Kothari. The results are given and are compared with those of other groups. A 300-kv particle accelerator provides neutrons by the (D,T) or (D,D) reaction. (W.D.M.)

26190 UCRL-5665(p.29-41)

Aktiebolaget Atomenergi, Stockholm.
RECENT PULSED NEUTRON WORK IN SWEDEN. N. G. Sjöstrand.

Some of the newer measurements in pulsed-neutron work in Sweden are reviewed. Theoretical problems are briefly discussed. (W.D.M.)

26191 UCRL-5665(p.42-53)

Kernreaktor Bau- und Betriebs-Gesellschaft m.b.H., Karlsruhe, Germany.
WORK WITH THE KARLSRUHE PULSED SOURCES. K. H. Beckurts.

Some of the recent pulsed-neutron work at Karlsruhe is described. The experimental setup and equipment are briefly discussed. Results are given for measurements on water, neutron age in graphite, and purity of commercial graphites. (W.D.M.)

26192 UCRL-5665(p.69-86)

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.
NEUTRON SPECTRUM MEASUREMENTS USING A PULSED NEUTRON SOURCE. M. J. Poole.

Experiments are described in which an attempt is made to determine the spectrum in a reactor lattice or moderator by a pulsed-source method. The experimental setup features a linear accelerator giving pulses of about 10^8 neutrons. The resolution is basically determined by the die-away time of the system. (W.D.M.)

26193 UCRL-5665(p.87-107)

California. Univ., Livermore. Lawrence Radiation Lab.
ALPHA MEASUREMENTS ON GRAPHITE- U^{235} SYSTEMS. Albert J. Kirschbaum.

Experiments are described which cover simple-geometry, enriched-uranium graphite systems with carbon-to-uranium atomic ratios from 300 up to about 10,000. The uranium was 94% enriched in U^{235} and the graphite had 14 ppm boron plus other neutron poisons ($I^2 = 1200 \text{ cm}^2$). The assemblies were constructed on a so-called low-mass table which was an expanded aluminum honeycomb with a thin aluminum plate on it. (W.D.M.)

26194 UCRL-5665(p.108-24)

Westinghouse Electric Corp. Bettis Atomic Power Div., Pittsburgh.
A FEW CONSIDERATIONS CONCERNING THE THEO-

RETICAL INTERPRETATION OF PULSED SOURCE EXPERIMENTS. A. F. Henry.

Results from an examination of the transient phase when the pulse is building up in pulsed source experiments are discussed. An attempt was made to compute the pulse decay rate and to verify the agreement between measured and computed values. The method of obtaining the decay rate consists in getting the fast and thermal spectra and from these deriving few-group constants. (W.D.M.)

26195 UCRL-5665(p.125-6)

Los Alamos Scientific Lab., N. Mex.

A REVIEW OF NEUTRON THERMALIZATION WORK AT LOS ALAMOS. Gordon E. Hansen.

Neutron-thermalization work at Los Alamos has consisted essentially in the building up of a computational capability for the study of intermediate reactors, especially graphite-moderated reactors, where the dependence of reactivity and fission density distribution on temperature or temperature distribution may be sensitive to the energy spectra of sub-cadmium neutrons. A very brief review of the work is given. (W.D.M.)

26196 UCRL-5665(p.162-6)

Los Alamos Scientific Lab., N. Mex.

INSTRUMENTATION FOR PULSED NEUTRON WORK AT LOS ALAMOS. PART II. W. R. Stratton.

The 350-kev Cockcroft-Walton type accelerator selected for pulsed-neutron experiments at Los Alamos is described. The external dimensions are 11 ft long, 6 ft wide, and 9 ft high. The beam tube is 7.5 ft off the floor. The ion source is of the cold-cathode type, capable of giving more than 1.5 ma continuous current. (W.D.M.)

26197 UCRL-5665(p.167-75)

California. Univ., Berkeley. Lawrence Radiation Lab. RECENT DEVELOPMENTS IN PULSED NEUTRON SOURCES AT LRL. Lawrence Ruby.

A relatively simple pulsed neutron source is described which is one of a class of crossed-field trapping devices. Construction and operational characteristics of the source are discussed. (W.D.M.)

26198 UCRL-9288

California. Univ., Berkeley. Lawrence Radiation Lab. ANTIPROTON-NUCLEON CROSS SECTIONS FROM 0.5 TO 1.0 BEV (thesis). Tommy Elioff. July 18, 1960. 90p. Contract W-7405-eng-48. OTS.

Antiproton-production and nucleon-interaction cross sections were determined for antiprotons in the energy range 0.5 to 1.0 bev. The production of antiprotons in hydrogen by 6.0-bev incident protons was investigated by observing the number of antiprotons produced in polyethylene and carbon targets within the Bevatron. The antiprotons were identified by a system of scintillation and velocity-selecting Cherenkov counters. The results indicated that antiproton production in hydrogen is negligible compared with production in carbon. The excitation function and momentum distribution were recorded for antiproton production in carbon and compared with statistical-model expectations. After the antiprotons made their exit from the Bevatron, they were directed by a system of bending and focusing magnets to a liquid hydrogen target. An array of plastic scintillation counters, which nearly surrounded the hydrogen target, was used to determine the p-p total, elastic, inelastic, and charge-exchange cross sections at five energies in the above energy range. It was found that the total cross sections are everywhere much larger than the n-n cross sections for comparable energies. Near 500 Mev the total p-p cross section is about 120 mb; it slowly decreases to 100 mb near 1 bev. The inelastic

cross section, which is principally due to the annihilation process, represents nearly $\frac{2}{3}$ of the total cross section. The elastic scattering distribution is highly peaked in the forward direction and can be fitted by optical-model analysis. The total and partial cross sections were also determined for the collisions of antiprotons with deuterons. The p-d cross sections were found to be approximately 1.8 times the p-p cross sections. Corrections were made for the shielding of nucleons within the deuteron so that the p-n interaction could be observed. The results indicate that the p-p and p-n cross sections are very nearly equal and that they satisfy the relations governed by charge independence. (auth)

26199 UCRL-9292

California. Univ., Berkeley. Lawrence Radiation Lab. EXPERIMENTS ON NEUTRON-PROTON SCATTERING AND DETERMINATION OF THE PION-NUCLEON COUPLING CONSTANT (thesis). Rudolf R. Larsen. July 5, 1960. 80p. Contract W-7405-eng-48. OTS.

The neutron-proton absolute differential cross section at 710 Mev was measured in hydrogen at nine angles within the range 180 to 160° (center-of-mass system) and in deuterium at two angles within the same range. The cross section in hydrogen exhibits a strong peaking toward 180°, which may be interpreted as charge-exchange scattering with small momentum transfer. The cross section in deuterium at 180° is 0.48 ± 0.08 of the cross section in hydrogen. This strong decrease is a manifestation of the Pauli principle. Charge-exchange scattering in deuterium leaves behind two protons in the final state and many such states are forbidden by the exclusion principle. In order to determine the pion-nucleon coupling constant the cross section in hydrogen was multiplied by x^2 ($x = 1.02927 + \cos(\phi_{cm})$) and extrapolated to $x = 0$, which is the position of the one-pion-exchange pole, by a least-square fitting with polynomials in x . The value of the extrapolated data should yield the pion-nucleon coupling constant. The least-square fitting indicated, however, that the data could not be adequately represented by a low-order polynomial. The data were further modified in an attempt to include multiple-pion-exchange contributions. The least-square fitting to the modified data indicated that a low-order polynomial did represent the data. When this method is used the value of the pion-nucleon coupling constant in which one can have the most confidence is $f^2 = 0.085 \pm 0.011$. (auth)

26200 UCRL-9297

California. Univ., Berkeley. Lawrence Radiation Lab. THE Λ -HYPERON MASS AND ENERGY SPECTRUM FROM THE NUCLEAR CAPTURE OF NEGATIVE K MESONS (thesis). Conrad J. Mason. July 7, 1960. 49p. Contract W-7405-eng-48. OTS.

In two emulsion stacks exposed to K^- -meson beams, a total of 128 Λ -like decays in which the secondaries came to rest were found by area scanning in the region of stopping K mesons. All these events were analyzed and 116 proved to be hyperons. The range-measurement techniques employed were essentially those used by Barkas and co-workers in determining the range-energy relation for emulsion. The emulsion densities and shrinkage factors were precisely determined in order to obtain reliable results. The Λ -hyperon mass as obtained from the analysis of the events in the first stack is 1115.30 ± 0.11 Mev (29 events); in the second, it is 1115.46 ± 0.09 Mev (87 events). The errors include the statistical and systematic errors associated with each stack. The two mass values are not inconsistent. The weighted mean mass is 1115.40 ± 0.14 Mev, where the total error arises from the statistical errors of the two determinations and from an 0.12-Mev error associated

with systematic effects, i.e., the error in the range-energy relation and the uncertainties in the rest masses of the secondaries. The corresponding Q value for the decay via the charged mode is 37.56 ± 0.13 Mev. The Λ -hyperon production spectrum from the capture of K^- mesons is presented. A description of a microscope equipped with automatic coordinate-readout devices is appended. (auth)

26201 UCRL-9336

California. Univ., Berkeley. Lawrence Radiation Lab. EXPERIMENT ON DOUBLE SCATTERING OF ANTIPROTONS IN HYDROGEN. (Talk given at Research Progress Meeting on August 11, 1960). Bogdan C. Maglić. Aug. 16, 1960. 17p. Contract W-7405-eng-48. OTS.

Double scattering of antiprotons of 1.65 beV/c in the 72-in. hydrogen bubble chamber was studied experimentally. A method for the simultaneous determination of the antiproton polarization and magnetic moment was proposed and applied in the analysis of 300 double-scattering events. An average polarization of 0.48 ± 0.09 was obtained in the angular region from 6 to 25° . The value of the antiproton magnetic moment was measured to be $\mu_{\bar{p}} = -1.9 \pm 1.4$ nuclear magnetons. (auth)

26202 UCRL-9354

California. Univ., Berkeley. Lawrence Radiation Lab. THE INTERACTIONS OF STRANGE PARTICLES. Luis W. Alvarez. Aug. 11, 1960. 60p. Contract W-7405-eng-48. OTS.

A corrected copy is presented of the author's talk given at the 1959 Kiev Conference on High Energy Physics. (W.D.M.)

26203 AEC-tr-3587

HYPERFRAGMENTS IN NUCLEAR EMULSIONS. B. P. Bannik, U. G. Gulyamov, D. K. Kop'lova (Kopylova), A. A. Nomofilov, M. I. Podgoretskiĭ (Podgoretskiy), B. G. Rakhimba'ev (Rakhimbayev), and M. Usmanova. Translated from *Zhur. Eksptl'. i Teoret. Fiz.* **34**, 286-97(1958). 24p. JCL or LC.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 12, as abstract No. 9251.

26204 AERE-Trans-853

RESONANCE ABSORPTION IN HETEROGENEOUS SYSTEMS. G. Memmert. Translated by E. L. Poole (U.K.A.E.A. Atomic Energy Research Establishment) from *Nukleonik* **1**, 48-57(1958). 27p.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 12, as abstract No. 13379.

26205

ANGULAR AND SPECTRAL DISTRIBUTIONS OF BACK-SCATTER RADIATION FROM SLABS OF WATER, BRASS, AND LEAD IRRADIATED BY PHOTONS BETWEEN 50 AND 250 keV. Gunnar Hettinger (Univ. of Lund, Sweden). *Acta Radiol.* **54**, 129-52(1960) Aug. (In English)

The energy distribution of radiation backscattered in different directions was measured in absolute units with a NaI-scintillation spectrometer. The recorded spectra were integrated over space to give the backscatter number flux. Build-up and albedo were calculated. Good agreement with backscatter factors was obtained. Once-scattered radiation and characteristic fluorescent radiation were theoretically calculated. The backscatter from brass and lead consisted mainly of once-scattered radiation and characteristic K-radiation, respectively. (auth)

26206

MASSLESS PARTICLES. R. H. Good, Jr. (Ames Lab., Ames, Iowa). *Am. J. Phys.* **28**, 659-66(1960) Oct.

A discussion is given of massless particles, especially the two-component neutrino and the photon, in the light of modern ideas about space reflection. The emphasis is on the physical arguments, and mathematical details are omitted. (auth)

26207

THEORY OF STRONG INTERACTIONS. J. J. Sakurai (Univ. of Chicago). *Ann. Phys. (N.Y.)* **11**, 1-48(1960) Sept.

A new theory of strong interactions is proposed on the basis of existing exact symmetries. The fundamental isospin current coupling in the static limit gives rise to a short-range repulsion (attraction) between two particles whenever the isospins are parallel (antiparallel). The theory explains why there are no "elementary" particles with baryon number greater than unity provided the baryonic current coupling is sufficiently strong. It is conjectured that there exists a deep connection between the law of conservation of fermions and the universal V-A weak coupling. Parity conservation in strong and electromagnetic interactions, and parity nonconservation in weak interactions can be understood from the single common principle of generalized gauge invariance. It is suggested that experimental attempts be made to detect directly quantum manifestations of the vector fields introduced in the theory, especially by studying Q values of pions in various combinations in NN annihilations and in multiple pion production. (B.O.G.)

26208

DETERMINATION OF ABSORPTION CROSS SECTIONS AND THE SCATTERING CROSS SECTION OF NATURAL NEON FOR THERMAL NEUTRONS. Robert Genin, Hans Beil, René Joly, and Michel Ribrag. *Compt. rend.* **251**, 691-3(1960) Aug. 1. (In French)

The measurement of the total cross section of neon permits the determination of the scattering cross section σ_s , and the determination of the upper limit of the absorption cross section σ_a for neutrons with a velocity of 2200 m/sec. The values obtained are $\sigma_s = 2.38 \pm 0.04$ b and $\sigma_a \leq 50$ mb. (tr-auth)

26209

THE INTRODUCTION OF STATISTICAL IDEAS IN THE QUANTUM MECHANICS OF PARTICLES WITH SPIN. Jean-Claude Aron. *Compt. rend.* **251**, 1117-18(1960) Sept. 5. (In French)

In previous studies a physical model for the spin wave was proposed, and the relations of the scattering theory with the quantum mechanics of a particle without spin were studied. In the present work, the statistical ideas are introduced into the mechanics of particles with spin and the measure in which they permit the definition of the physical model is examined. (tr-auth)

26210

GAUGE INVARIANCE OF PHOTON MASS, AND ASYMPTOTIC FORM OF THE PHOTON PROPAGATOR. Bernard Juvet. *Compt. rend.* **251**, 1119-21(1960) Sept. 5. (In French)

A solution to the old paradox of the incompatibility of the gauge invariance with the certain existence of a zero mass of the photon is given. A primary integral of quantum electrodynamic equations is deduced and expressed as an identity causing the fine structure constant (α) to become effective. The integral should satisfy the photon propagator (Δ_F^p). This equation determines the asymptotic form of Δ_F^p at all orders of α . (tr-auth)

26211

FORMATION OF CHARGE-CARRYING MESONS BY 290-

Mev NEGATIVE PIONS ON HYDROGEN. Yu. A. Batusov, N. P. Bogachev, S. A. Bunyatov, V. M. Sidorov, and V. A. Yarba (Joint Inst. for Nuclear Research, Dubna, USSR). Doklady Akad. Nauk S.S.S.R. **133**, 52-5(1960) July 1. (In Russian)

The angular and energy characteristics of secondary particles from $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ at a primary π energy of 290 Mev were studied. The obtained distributions were correlated with those predicted by the Fermi statistical theory and the Lindenbaum and Sternheimer isobar model; good agreement was obtained for the energy distributions. However, the angular distributions do not agree. (R.V.J.)

26212

AN INVESTIGATION OF THE ANGULAR CORRELATION OF THE γ -QUANTA PRODUCED BY THE ANNIHILATION OF POSITRONS AND ELECTRONS IN BISMUTH. I. Ya. Dekhtyar and V. S. Mikhalev (Inst. of Metal Physics, Academy of Sciences, Ukrainian SSR). Doklady Akad. Nauk S.S.S.R. **133**, 60-3(1960) July 1. (In Russian)

The angular distribution of γ quanta from positron and electron annihilation was studied with a special device designed for measuring the intensity of coincidence pulses at various angles. A Na^{22} positron source, a scintillation counter, and a 2-mm thick monocrystal of bismuth were used in the experiment. The typical angular distribution curves were plotted with consideration for background at 15° intervals from 0 to 180° . The distribution curves indicated: half-width distribution $b_x/2 = 5.25 \times 10^{-3}$ rad and $b_y/2 = 5.8 \times 10^{-3}$ rad; mean maximum pulses $p_{mx} = 3.76$ mc and $p_{my} = 4.22$ mc. The maximum anisotropy of saturated energy levels (in half-widths) is 10.5% and the maximum anisotropy according to mean maximum pulses is 12.2%. (R.V.J.)

26213

REDUCTION OF THE RELATIVISTIC INTEGRAL OF COLLISIONS TO BOLTZMANN'S FORM. N. A. Chernikov (Joint Inst. for Nuclear Research, Dubna, USSR). Doklady Akad. Nauk S.S.S.R. **133**, 84-7(1960) July 1. (In Russian)

The integral for relativistic elastic collisions was reduced to a Boltzmann form, and it is shown that for a Maxwellian particle distribution the collision integral reduces to 0. (R.V.J.)

26214

RIGOROUS DERIVATION OF THE PHASE SHIFT FORMULA FOR THE HILBERT SPACE SCATTERING OPERATOR OF A SINGLE PARTICLE. T. A. Green and O. E. Lanford, III (Wesleyan Univ., Middletown, Conn.). J. Math. Phys. **1**, 139-48(1960) Mar.-Apr.

For a single nonrelativistic particle moving in a spherically symmetric potential, the existence of the Hilbert space wave operators and S operator was proved and phase shift formulas for these operators were deduced. The probability, $P(\Omega)$, for scattering into the solid angle Ω was obtained from the time dependent theory. The relation between $P(\Omega)$ and the R matrix of the standard plane wave formulation of scattering theory is established. For collimated incoming packets, it is shown that $P(\Omega)$ can be expressed as an energy average of the differential cross section. (auth)

26215

ANALYTICITY OF THE FOURTH ORDER SCATTERING AMPLITUDE WITH TWO COMPLEX INVARIANTS. Jan Tarski (Univ. of California, Berkeley). J. Math. Phys. **1**, 149-63(1960) Mar.-Apr.

The partial Feynman amplitude corresponding to a particular fourth order diagram was examined as a function of

energy and momentum transfer with both of these variables complex. The region of regularity of this function was found, and the types of singularities at the remaining points were determined. An approach that requires only elementary calculations was indicated. The condition for the validity of Mandelstam's representation in the fourth order was obtained. Spectral representations for exchange scattering processes at fixed momentum transfer are discussed as another application of the principal results. (auth)

26216

UNIFORM NORMALIZATION OF PLANE WAVES WITH SPIN $1/2$ UNDER INVERSION OPERATORS. K. H. Tzou (Institut Henri-Poincaré, Paris). J. phys. radium **21**, 579-86(1960) July. (In French)

The possibility of a uniform normalization of monochromatic plane waves is examined with respect to inversion operations. It is shown that such a normalization is realizable for each of the eight unitary inversions, but not for the anti-unitary ones, except C and PTM. A uniform normalization is even possible for many inversions simultaneously, in particular for the four operations CPT, M, CT, and PM. Owing to the existence of uniform normalization of plane waves with respect to unitary inversions, we find finally spinor field operators that are invariant under these inversions, especially under CPT, M, CT, and PM. (auth)

26217

ON ELECTROMAGNETIC RADIATION IN MAGNETO-IONIC MEDIA. Herwig Kogelnik (Engineering Lab., Oxford). J. Research Natl. Bur. Standards **64D**, 515-23(1960) Sept.-Oct.

A method of treating radiation problems in magneto-ionic (anisotropic) media is presented. A "wave matrix" is defined, the zeros of whose determinant are the propagation constants of the ordinary and the extraordinary plane waves. A derivation of the dyadic Green's function for the unbounded medium is given, which is also based on this matrix. A formula is arrived at, which gives the power radiated by any distribution of alternating current in terms of the wave matrix and the spatial Fourier transforms of the currents. The method is illustrated by a discussion of the power radiated by an elementary dipole. (auth)

26218

DETERMINATION OF DENSITY DISTRIBUTION OF PARTICLE PULSE PROBABILITIES BY EXPERIMENTS WITH SCATTERING. N. A. Chernikov (Joint Inst. for Nuclear Research, Dubna, USSR). Nauch. Doklady Vysheĭ Shkoly, Fiz.-Mat. Nauki No. 3, 151-7(1959). (In Russian)

The density distribution of nucleon pulse probabilities (in events where the particle interactions with one nucleon take place independently of other nucleons, and where multiple particle collisions are improbable) were determined previously by considering the influence of intrinsic nucleon motion on particle scattering probabilities. In contrast to the above, experiments were made with relativistic particles. Moreover, an integral equation was developed for the density distribution of pulse probabilities which allow the determination of density without assuming a priori a certain definite pulse dependence. (R.V.J.)

26219

WHAT IS CIRCULAR POLARIZATION? K. Nowak. Neue Physik No. 6, 177-87(1959). (In German)

Electrons are considered as polarized when their spin is preferably oriented. If the spin axis lies in the direction of motion, this is longitudinal polarization; if the spin

direction is perpendicular to the impulse direction, this is transverse polarization. The electromagnetic waves of radiant radiations should on the contrary hold to the valid concept of universal character, and the polarization of light regarded as the mark of a plane of vibration. In circular polarization this plane of vibration is turned. This definition is pursued further with discussion including photon theory. (T.R.H.)

26220

INTERACTIONS OF 6.2 GeV PROTONS IN EMULSIONS. I. GENERAL RESULTS. H. Winzeler, B. Klaiher, W. Koch, M. Nikolić, and M. Schneeberger (Universität, Bern). *Nuovo cimento* (10) **17**, 8-34(1960) July 1. (In English)

About 700 interactions were found by studying the tracks of 6.2-Bev protons. An interaction mean free path of (38.2 ± 1.5) cm was obtained. Forty-two possible proton-free proton collisions were separated, and the cross section for meson production was found to be 23^{+7}_{-4} mb. An average multiplicity for charged secondary tracks in inelastic p-p collisions of 2.8 ± 0.3 was found, and the branching ratio of 2 prong to 4 prong events was about 2. These values were compared with the predictions of the statistical theory and with a modification of it. The results of this investigation are consistent with a model which assumes that at these energies about 50% of all collisions are ones that lead to (nucleon) isobar (NN^* or N^*N^*) formation only. The angular distribution of all thin secondary tracks in the L system were measured, and the formula of Castagnoli et al. was applied to a reasonably selected sample of stars. This gave an overestimation by a factor of about 2 for the primary energy. Other investigators obtained a similar value at 10^{12} ev. (auth)

26221

ON THE TWO FLUID MODEL IN MULTIPLE PRODUCTION OF MESONS. M. Hamaguchi (Kyoto Univ.). *Nuovo cimento* (10) **17**, 35-44(1960) July 1. (In English)

The mechanism of multiple particle production in high-energy nucleon-nucleon collisions was investigated using the two-fluid model. The theoretical inelasticity was numerically calculated. (auth)

26222

THE EXCITED NUCLEON'S MODEL OF MESON PRODUCTION. U. Maor and G. Yekutieli (Weizmann Inst. of Science, Rehovoth, Israel). *Nuovo cimento* (10) **17**, 45-67(1960) July 1. (In English)

A model of meson production from excited nucleons is described for both nucleon-nucleon and nucleon-nucleus collisions induced by cosmic-ray particles. The results are compared with observations in photographic emulsions, and reasonable agreement is found. (auth)

26223

THEORY OF LOW ENERGY NUCLEON-NUCLEON SCATTERING. [PART] I. D. Amati, E. Leader, and B. Vitale (European Organization for Nuclear Research, Geneva). *Nuovo cimento* (10) **17**, 68-97(1960) July 1. (In English)

The nucleon-nucleon interaction at energies below the threshold for inelastic processes, was studied, using a method based on the Cini-Fubini approach to the double integral representation technique. The essential idea was to treat all the singularities of the amplitudes for values of the variables lying near their physical region, taking full advantage of the symmetry of the Mandelstam representation. The spectral functions were calculated using unitarity, both in the nucleon-nucleon and in the nucleon-antinucleon channels. In the latter the two-pion contribution was calculated in terms of pion-nucleon scattering and contained amplitudes characterizing the low waves of the $NN \rightarrow 2\pi$

process. The construction of integral equations for the partial-wave amplitudes is discussed. The nucleon-nucleon amplitude was developed in terms of linear combinations of the Fermi operators chosen to have simple properties under crossing, and whose invariant coefficients were shown to satisfy a Mandelstam representation in 4th order perturbation theory. (auth)

26224

THE ANGULAR DISTRIBUTION OF SECONDARY π -MESONS FROM 4.5 GeV π^- AND 6 GeV PROTON INTERACTIONS IN EMULSION. H. H. Aly and C. M. Fisher (Univ. of Bristol, Eng.). *Nuovo cimento* (10) **17**, 98-105(1960) July 1. (In English)

The angular distributions of π mesons produced in two hundred 4.5 BeV π^- and two hundred 6 BeV proton interactions with emulsion nuclei were investigated. It was found that the pions from the 6 BeV proton-induced interactions were consistent with an isotropic distribution in the C-system while the pions from the 4.5 BeV π^- induced interactions had an anisotropic distribution peaked in the forward direction. The degree of anisotropy was larger with smaller N_h values. (auth)

26225

MEASUREMENT OF THE MUON MASS BY CRITICAL MESIC X-RAY ABSORPTION. I. SCINTILLATION SPECTROMETRY. J. Lathrop, R. A. Lundy, V. L. Telegdi, R. Winston, and D. D. Yovanovitch (Univ. of Chicago). *Nuovo cimento* (10) **17**, 109-13(1960) July 1. (In English)

Mesic x rays from a phosphorus target were analyzed with and without lead absorbers with a NaI(Tl) spectrometer in order to study the $3D \rightarrow 2P$ transition in the mesic phosphorus. The absorption coefficient of the lead absorber was determined; the transition energies of the mesic x rays can easily be determined when this is known. Positions of the two main components of the $3D \rightarrow 2P$ transition of μ -mesic phosphorus with respect to the lead K-edge and lead absorption curves for the three assumed muon masses are given. (M.C.G.)

26226

MEASUREMENT OF THE MUON MASS BY CRITICAL MESIC X-RAY ABSORPTION. II. PROPORTIONAL COUNTER SPECTROMETRY. J. Lathrop (Univ. of Chicago), R. A. Lundy, S. Penman, V. L. Telegdi, R. Winston, D. D. Yovanovitch, and A. J. Bearden. *Nuovo cimento* (10) **17**, 114-18(1960) July 1. (In English)

The advantages of proportional counters for a study of the critical absorption of the 88-kev $3D \rightarrow 2P$ transition of mesic phosphorus are given. Their use in measuring the absorption coefficients is described. Mesic x-ray spectra from a red phosphorus target were recorded with and without lead absorbers. A list of the experimental transmitted intensities for given absorber thickness and lead absorption curves corresponding to the assumed muon masses is given. (M.C.G.)

26227

THE CHARACTERISTIC-FUNCTIONAL METHOD IN CASCADE THEORY. J. W. Gardner (English Electric Co., Ltd., Whetstone, Leics., Eng.). *Nuovo cimento* (10) **17**, 205-18(1960) July 16. (In English)

The last-collision equation treatment of the general Markoff cascade was developed previously and applied to examples drawn from cosmic radiation and nuclear reactor theory. An alternative approach is given via the characteristic functional, the latter being introduced as a logical extension of the concept of a moment-generating function. Potentially the characteristic functional (C.F.) embodies

complete information about all the probability relations of the stochastic process in question. In practice the extraction of information about any particular distribution depends on a suitable choice of the arbitrary auxiliary function occurring in the definition of the C.F. The power and versatility of the method are illustrated by reference to both point-source and extended-source cascades. It is particularly suited to the treatment of cascades from line sources, examples of which would be, in descending order of energy, a high-energy nuclear jet; the track of an ionizing particle; and the source representation in the Feinberg-Galanin method of nuclear reactor theory. (auth)

26228

PRODUCTION OF BREMSSTRAHLUNG BY LONGITUDINALLY POLARIZED ELECTRON-PROTON COLLISIONS. Sasabindu Sarkar (Indian Assn. for the Cultivation of Science, Calcutta). *Nuovo cimento* (10) **17**, 219-23(1960) July 16. (In English)

The differential cross section for the production of bremsstrahlung in the high-energy collisions of longitudinally polarized electrons and protons was calculated considering the effect of the anomalous magnetic moment and the recoil of the proton. The matrix element for the bremsstrahlung of the proton was neglected and so the formula is valid when the angle between the directions of the electron and the photon is of the order of mc/p (m and p being the mass and momentum of the electron, respectively). (auth)

26229

PION PHOTON SCATTERING. M. Gourdin (Faculté des Sciences, Bordeaux) and A. Martin. *Nuovo cimento* (10) **17**, 224-43(1960) July 16. (In English)

Combining the assumption of a Mandelstam representation with approximate unitarity, the pion-photon scattering amplitude was obtained in terms of the pion-pion scattering amplitude in even states and the matrix element for photoproduction of pions on pions. In solving this problem attention was paid to the fact that in the low energy limit this amplitude should become equal to the classical amplitude. With some simplifying assumptions an expression was obtained which contains four quantities: the two pion S-phase shifts, the total cross-section for photoproduction of pions on pions, and the electromagnetic coupling constant. Numerical estimates will be given later. The interest of studying this process lies in its possible influence on the nucleon-photon scattering. (auth)

26230

UPPER LIMIT FOR THE INTRINSIC ELECTRIC DIPOLE MOMENT OF THE PROTON AND THE NEUTRINO. S. Rosendorff (Washington Univ., St. Louis). *Nuovo cimento* (10) **17**, 251-8(1960) July 16. (In English)

The elastic scattering of electrons by a proton with an intrinsic electric dipole moment was calculated in first Born approximation. The cross section was quite sensitive to the electric dipole moment interaction at high energies and large angles. It therefore appeared likely that high-energy electron-proton scattering could give valuable information of the value or upper limit of the proton electric dipole moment coupling strength. Certain spin correlation effects between the recoil proton and the initial electron arising from the electric dipole moment interaction are discussed. The calculation of the ionization power of a neutrino due to its intrinsic electric dipole moment is briefly outlined and compared with the experimental results of Cowan and Reines. (auth)

26231

SEARCH FOR ANTINEUTRON ANNIHILATION EVENTS IN NUCLEAR EMULSIONS. Tsai-Chü, M. Morand, G. Bourlet, C. Simonin, and D. Schune (Faculté des Sciences, Paris). *Nuovo cimento* (10) **17**, 259-62(1960) July 16. (In English)

In the scanning of antiproton tracks, five antineutron events were found. A reproduction of one of the events is given. The star had 17 prongs involving an associated production of $K^- - K^0$ mesons, with the K^0 decaying as θ^0 into two π^0 's immediately after production and each π^0 in turn decaying into a Dalitz pair and a γ ray. The two electron pairs formed four of the tracks, the K^- meson formed another, and three knock-on protons, a low-energy electron, an α particle, and eight evaporation protons formed the remaining tracks. (M.C.G.)

26232

SOME REMARKS ABOUT THE SPECTRAL REPRESENTATION OF THE $K^+ \rightarrow 3\pi$ DECAY AMPLITUDE. S. Fubini (European Organization for Nuclear Research, Geneva) and R. Strohlini. *Nuovo cimento* (10) **17**, 263-6(1960) July 16.

An approximate solution of an integral equation for the $K^+ \rightarrow 3\pi$ decay amplitude enabled some information to be obtained about S-wave pion-pion interactions. The unphysical case in which the mass of the K meson is of the same order of magnitude as the pion mass is considered. (M.C.G.)

26233

REMARKS ON NEUTRAL PION PHOTOPRODUCTION IN THE HIGH ENERGY REGION. C. Pellegrini and G. Stopini (Comitato Nazionale per le Ricerche Nucleari, Frascati, Italy). *Nuovo cimento* (10) **17**, 269-73(1960) July 16. (In English)

Two models for the photoproduction of mesons (π^0) on protons are considered. In the first model it was assumed that the second resonance was excited through a magnetic dipole absorption leading to a state $T = \frac{1}{2}$, $J = \frac{3}{2}$, with positive parity. In the second model the multipole involved was assumed to be the electric dipole leading to the same state but with opposite parity. The polarization of protons emitted at 90° in the center-of-mass system was obtained. (M.C.G.)

26234

FORWARD ANGLE PHOTOPRODUCTION OF SINGLE POSITIVE PIONS ON HYDROGEN. M. Beneventano, G. Finocchiaro, R. Finzi, L. Mezzetti, L. Paoluzzi, and C. Schaerf (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). *Nuovo cimento* (10) **17**, 274-8(1960) July 16. (In English)

Angular distribution measurements were made for the photoproduction of mesons (π^+) on hydrogen at angles between 10 and 90° . Measurements were also made at photon energies of 600 to 900 Mev at 20 and 90° . In the results, the energy dependence at fixed center-of-mass angles appeared to have a maximum at lower energies than previously reported. A steeper dependence on energy of differential cross sections in the region around 700 Mev was also noted. (M.C.G.)

26235

PROTON HELICITY FROM A DECAY. Robert W. Birge and William B. Fowler (Univ. of California, Berkeley). *Phys. Rev. Letters* **5**, 254-7(1960) Sept. 15.

A necessary consequence of parity nonconservation is the longitudinal polarization of the decay proton from unpolarized Λ hyperons decaying at rest. This longitudinal

polarization appears as a partial transverse polarization when a Λ decays in flight. Measurements of the helicity of the proton were obtained in scattering experiments. For each analyzed event the angle between the spin and direction of motion of the proton was computed. The sine of this angle divided into the transverse polarization, found as a function of incoming momentum and scattering angle, gave the longitudinal polarization. The data gave a value of -0.45 ± 0.4 for the longitudinal polarization. This indicated a positive helicity for the proton in contradiction to theory. (M.C.G.)

26236

POSSIBLE ANOMALY IN MESON PRODUCTION IN $p + d$ COLLISIONS. Alexander Abashian, Norman E. Booth, and Kenneth M. Crowe (Univ. of California, Berkeley). Phys. Rev. Letters **5**, 258-60(1960) Sept. 15.

Proton-deuteron interactions were studied for the possibility of detecting new particles. The He^3 momentum spectra were measured for incident proton energies of 624 to 743 Mev. The data were inconsistent with the relativistically invariant phase space assumed. The discrepancy appeared in the form of a narrow peak which kinematically behaved like a system with a mass or total energy of 310 ± 10 Mev. The natural line width of this system was not more than 16 Mev. Plausible explanations of the line are the existence of a new neutral particle or a resonant $\pi-\pi$ system. The possible isotopic spin assignments are $I = 1$ or $I = 0$. (M.C.G.)

26237

ELECTRON SCATTERING FROM THE PROTON. F. Bumiller, M. Croissiaux, and R. Hofstadter (Stanford Univ., Calif.). Phys. Rev. Letters **5**, 261-3(1960) Sept. 15.

A large double-focusing magnetic spectrometer, capable of analyzing electrons or other singly-charged particles up to a momentum of 1000 Mev/c, was used in studies of electron scattering from protons at incident electron energies of 650 to 900 Mev between scattering angles of 45 and 145°. Typical electron peaks are shown. Values are given for scattering angle, cross section, and square of the momentum transfer. (M.C.G.)

26238

SPLITTING OF THE PROTON FORM FACTORS AND DIFFRACTION IN THE PROTON. R. Hofstadter, F. Bumiller, and M. Croissiaux (Stanford Univ., Calif.). Phys. Rev. Letters **5**, 263-5(1960) Sept. 15.

Separate proton form factors were obtained from electron scattering studies by choosing a pair of experimentally measured cross sections at the same value for the square of the momentum transfer but at different values of electron energy and scattering angle. The proton form factors obtained were plotted against the square of the momentum transfer. The new F_2 indicated that the Pauli magnetic moment cloud is a spread-out distribution. The constancy of F_1 , however, suggested that the Dirac electric/magnetic cloud has a small, perhaps point-like, core. (M.C.G.)

26239

BOUNDARY CONDITION MODEL FOR PROTON-PROTON SCATTERING. D. P. Saylor, R. A. Bryan, and R. E. Marshak (Univ. of Rochester, N. Y.). Phys. Rev. Letters **5**, 266-8(1960) Sept. 15.

A boundary condition model for proton-proton scattering, which features potential tails, was found to yield a good description of the p-p data up to 310 Mev. The boundary conditions were applied at the same radius for all states of a given spin angular momentum. Preliminary values of the boundary conditions were obtained by inward stepwise cal-

culations of the wave functions for each state. The boundary condition method was also tried with the one-pion exchange potential in the outer region. (M.C.G.)

26240

FORM OF THE ONE-PION EXCHANGE POTENTIAL. G. Breit, M. H. Hull, Jr., K. Lassila, and H. M. Ruppel (Yale Univ., New Haven). Phys. Rev. Letters **5**, 274-6(1960) Sept. 15.

The correctness of the mathematical form of the one-pion exchange potential was tested. The tests were made by modifying the form through the introduction of additional terms multiplied by dimensionless parameters. These tests indicated the absence of large deviations from the one-pion exchange potential and furnished a confirmation of it. (M.C.G.)

26241

DEUTERON PRODUCTION OF HIGH-ENERGY COLLISIONS. R. Hagedorn (European Organization for Nuclear Research, Geneva). Phys. Rev. Letters **5**, 276-7(1960) Sept. 15.

Deuteron production in proton-proton collisions was calculated by means of the statistical theory. Relative cross sections and neutron/proton ratios were calculated for an incident proton energy of 25 Bev. Results from the statistical method show that this "elementary production" yields the correct orders of magnitude. This picture of the deuteron as a quasi-elementary particle is supported by kinematical considerations. (M.C.G.)

26242

PRODUCTION OF PARTICLE BEAMS AT VERY HIGH ENERGIES. S. D. Drell (Stanford Univ., Calif.). Phys. Rev. Letters **5**, 278-81(1960) Sept. 15.

Photons were found to be very effective in initiating colimated beams of high-energy charged particles. Production cross sections were computed in terms of the pion electromagnetic vertex for a real photon multiplied by the total cross section for a pion incident on the target leading to all the particles produced in the final state other than the observed pion. The production of pions by an incident proton beam on a hydrogen target was compared with the photoproduction. Production of K meson, baryon, nucleon, and hyperon beams with photons was also considered. (M.C.G.)

26243

MUON MASS AND CHARGE BY CRITICAL ABSORPTION OF MESONIC X RAYS. S. Devons, G. Gidal, L. M. Lederman, and G. Shapiro (Columbia Univ., New York). Phys. Rev. Letters **5**, 330-2(1960) Oct. 1.

The high precision currently available in determinations of the muon magnetic moment has stimulated efforts to measure the muon mass directly to high precision. The 88-kev photons emitted in the transition from the 3D to the 2P state of a negative μ meson in orbits about a phosphorus nucleus were used in making such measurements. This mesonic x ray is known to have energy very close to the K absorption discontinuity of lead. Uncorrected mass absorption coefficients, μ_p , were obtained at 71 kev (2.83 ± 0.03 cm²/g), and at 123 kev (3.06 ± 0.05 cm²/g). When corrected for average oblique traversal, and for forward Compton and coherent scattering from the lead which still reaches the detector, good agreement is obtained with attenuation coefficients. The measurements yield the mass ratio $m_\mu/m_e = 206.78$ and the charge ratio $e_\mu/e_e = 1 \pm (5 \times 10^{-5})$. (B.O.G.)

26244

TOTAL CROSS SECTIONS FOR p , \bar{p} , K^\pm , AND π^\pm ON

HYDROGEN BETWEEN 3 AND 10 GeV/c. G. von Dardel, D. H. Frisch, R. Mermod, R. H. Milburn, P. A. Piroué, M. Vivargent, G. Weber, and K. Winter (European Organization for Nuclear Research, Geneva). *Phys. Rev. Letters* **5**, 333-6(1960) Oct. 1.

On the basis of dispersion relations, it was shown that if the total cross sections for a particle and its antiparticle on hydrogen approach constant values at high energies, then these limits must be equal. For energies of a few bev, the total cross sections are still quite different for both nucleons and K particles. The beam from the 25-bev CERN proton synchrotron was used to explore the elementary particle cross sections at a momentum range of 3 to 10 bev/c. Illustrations are included for the velocity spectrum of the negative beam of 8-bev/c momentum; the experimental layout; and the total cross sections for (\bar{p}, p), (p, p), (K^-, p), (K^+, p), (π^-, p), and (π^+, p) as functions of momentum. The results indicate that the total cross sections of charged nucleons, pions, and K mesons tend to approach constant values at high energies. For both K mesons and nucleons the difference in the particle-antiparticle cross section on H and the weak dependence on energy suggests that the limiting equality previously predicted is reached, if at all, only at energies considerably higher than 10 bev/c. The positive and negative pion cross sections are equal to within the systematic uncertainty. (B.O.G.)

26245

PHOTOPRODUCTION OF CHARGED MESONS FROM DEUTERIUM AND THE π^-/π^+ RATIO. William P. Swanson, Duane C. Gates, Thomas L. Jenkins, and Robert W. Kenney (Univ. of California, Berkeley). *Phys. Rev. Letters* **5**, 336-9(1960) Oct. 1.

A 4-in. deuterium bubble chamber was used to observe the reactions $\gamma + d \rightarrow \pi^- + 2p$ and $\gamma + d \rightarrow \pi^+ + 2n$ at photon energies from threshold to 194 Mev. In the first reaction sufficient final-state information was obtained to determine the kinematical parameters required to calculate the Coulomb effects. By correcting the observed ratio $R_d = [\sigma(\gamma d \rightarrow \pi^-)]/[\sigma(\gamma d \rightarrow \pi^+)]$ to account for the final-state Coulomb interactions, values were obtained for the ratio $R = [\sigma(\gamma n \rightarrow \pi^-)]/[\sigma(\gamma p \rightarrow \pi^+)]$. These values are tabulated for energies of 152 to 175 Mev. The second reaction, which is followed by $\pi^+ \rightarrow \mu^+ + \nu$ decay, was identified by the characteristic range and electron decay of the muon. Before Coulomb correction, the average ratio was $R_d = 1.38 \pm 0.12$; after corrections the average ratio was $R = 1.27 \pm 0.11$. The photon energy distribution for the negative photopion events at 158 to 165 Mev is illustrated. (B.O.G.)

26246

TOTAL CROSS SECTION FOR $\gamma + n \rightarrow \pi^- + p$ NEAR THRESHOLD BY CHEW-LOW EXTRAPOLATION. William P. Swanson, Duane C. Gates, Thomas L. Jenkins, and Robert W. Kenney (Univ. of California, Berkeley). *Phys. Rev. Letters* **5**, 339-41(1960) Oct. 1.

The basic reaction was investigated near threshold by measuring the ratio $R_d = \sigma(\gamma + d \rightarrow \pi^- + 2p)/\sigma(\gamma + d \rightarrow \pi^+ + 2n)$, and inferring the parameters of interest from R_d and the measured cross section for the reaction $\gamma + p \rightarrow \pi^+ + n$. A new approach to the study of the basic reaction is possible through a Chew-Low extrapolation of certain recoil-nucleon momenta into the nonphysical region. The total cross section near threshold on free stationary neutrons, deduced directly from the extrapolation, involves no uncertainties arising from the presence of the second nucleon in the target deuteron. When the method is specialized to treat the reaction $\gamma + d \rightarrow \pi^- + 2p$ near threshold, the

data are extrapolated to a pole in the transition amplitude in the nonphysical region of negative kinetic energy of the recoiling spectator proton. The results of extrapolations to the desired cross sections at energies of 153.4 to 174.1 Mev for the free nucleon reaction $\gamma + n \rightarrow \pi^- + p$ are tabulated. (B.O.G.)

26247

PION PARAMETERS FROM HIGH-ENERGY INELASTIC INTERACTIONS. S. D. Drell (Stanford Univ., Calif.). *Phys. Rev. Letters* **5**, 342-4(1960) Oct. 1.

The physical principle that a transition amplitude has a pole for real one-particle intermediate states was employed to study the photoproduction of secondary beams of high-energy particles. Photons were found to be very effective in initiating collimated beams of some very high-energy strongly interacting particles. The "polology" considerations are applied to further experiments in order to check their quantitative content, as well as to determine parameters of interest in pion physics such as the strengths of the ($\pi\pi\pi$), ($\gamma\pi\pi$), and ($\pi\pi\pi$) interactions. A straightforward extension is proposed to different inelastic processes in the work of Chew and Low. The main point is illustrated by comparing the diagrams for the one-pion contribution to elastic and inelastic nucleon-nucleon scattering. (B.O.G.)

26248

LIGHT QUANTA AND HEAVY BOSONS. H. Fröhlich (Univ. of Liverpool). *Proc. Roy. Soc. (London)* **A257**, 283-90 (1960) Sept. 20.

A new treatment of space-time reflections led to wave equation solutions that describe π^- and K-mesons with correct isobaric spin properties. Generalization of this wave equation led to an isobaric spin triplet (π -mesons), a singlet with zero mass (Maxwell equations, light quantum), an isobaric spin quadruplet with zero mechanical spin (K-mesons), and a particle with equal isobaric spin properties, but unit mechanical spin. (auth)

26249

THE INTERACTION OF 970 Mev PROTONS WITH HELIUM. L. Riddiford and A. W. Williams (Univ. of Birmingham, Eng.). *Proc. Roy. Soc. (London)* **A257**, 316-25(1960) Sept. 20.

The interaction of 970-Mev protons with helium was studied with a high-pressure diffusion cloud chamber. From 642 events the total and absorption cross sections were found to be 116 ± 17 mb and 93 ± 13 mb, respectively. These agree with values obtained by extrapolation of known cross sections for more complex nuclei, and the results are interpreted in terms of the optical model of the nucleus. The angular distribution for elastic scattering yields an α -particle radius of 1.8×10^{-13} cm. Quasi-elastic proton-proton and proton-neutron scattering, and more particularly charged meson production, show that the α particle has some individual particle characteristics. Meson reabsorption appears unimportant. (auth)

26250

ELEMENTARY PARTICLES AND SYMMETRY PRINCIPLES. M. A. Melvin (Florida State Univ., Tallahassee). *Revs. Modern Phys.* **32**, 477-518(1960) July.

The mass levels of various elementary particles of non-zero rest mass and their decay modes are given. The particles were grouped into three main categories in order of increasing mass. The theoretical problems of the existence and behavior of the elementary particles are discussed. The connection between symmetry principles and constants of motion were studied. The symmetry prin-

ciples that are expected to hold generally for the fundamental laws of nature and their associated redescriptions of dependent variables are given. The groups and representatives including concepts of transformation and invariance, the Lorentz group, decomposability of matrices to block-diagonal form and reducibility to semiblock-diagonal form, conditions for indecomposability, physical motivation, and the Lie Algebra of a continuous group are discussed. Invariance and its relation to the relativistic quantum theory, extensions of the Poincaré group, other conservations and symmetries, and the recent history of the universal Fermi interaction are also discussed.

(M.C.G.)

26251

A RETARDING FIELD APPARATUS FOR THE MEASUREMENT OF ENERGY AND ANGULAR DISTRIBUTIONS OF SCATTERED ELECTRONS. M. Horstmann and G. Meyer (Universität, Hamburg). *Z. Physik* **159**, 563-83(1960). (In German)

In a previous paper (*Z. Physik* **154**, 633(1959)) direct electron-intensity measurements in Debye-Scherrer diagrams of aluminum were described. A retarding-field apparatus was used for investigations into the influence of crystal size and electron energy (15 to 50 kev) on the elastic diffraction intensities. The validity range of the kinematical theory could be determined. By means of a retarding field the inelastically scattered electrons were separated from the elastically scattered electrons (energy loss below 2 ev). In this paper the retarding-field apparatus by which scattering intensities can be measured with good accuracy ($\approx 2\%$) is described in detail. It is compared with other arrangements for the measurements of angular and energy distributions of scattered electrons. (auth)

26252

THE ARBITRARY INCIDENT OF A PLANE ELECTROMAGNETIC WAVE ON THE CONDUCTING DISK. V. N. Kuritsyn (Leningrad Inst. of Physics and Tech.). *Zhur. Tekh. Fiz.* **30**, 790-8(1960) July. (In Russian)

The diffraction of an arbitrarily polarized plane electromagnetic wave at a conducting disk was investigated. Formulas are derived for induced current densities and total scattering cross sections. However, the practical applications of the formulas are limited by a condition demanding small parameters, ka ($k = a/c$ is the wave number of the emission incidence on the disk, a is the disk radius). The calculations are precise within an order of $(ka)^4$ for current density and $(ka)^7$ for cross sections. (tr-auth)

26253

THE PASSAGE OF CHARGED PARTICLE OR CHARGED DISK THROUGH THE ELECTRON-ION BEAM. N. L. Tsintsadze (Inst. of Physics, Academy of Sciences, Georgian SSR, Tbilisi). *Zhur. Tekh. Fiz.* **30**, 913-19(1960) Aug. (In Russian)

The energy loss of charged particles and disk-shaped particle bunches with uniformly distributed charges moving at a constant rate along the axis of a relativistic electron-ion beam was evaluated. An expression is derived for the Cherenkov radiation intensity, and the emission spectrum was determined. The wave guide radius corresponding to a maximum emission intensity at a given frequency, ω , was found. (tr-auth)

26254

ABOUT FUNCTION OF SPEED DISTRIBUTION OF ELECTRONS FOR POSITIVE DISCHARGE OF MIDDLE PRESSURE. Yu. M. Kagan and K. S. Mustafin (Leningrad State Univ.). *Zhur. Tekh. Fiz.* **30**, 938-47(1960) Aug.

Electron velocity distribution functions are calculated for positive neon, argon, and mercury columns considering elastic and inelastic impacts. The mean energy and directed velocities are correlated with probe measurements. (tr-auth)

26255

INVARIANCE PROPERTIES IN ELEMENTARY PARTICLE PHYSICS. Abdus Salam (Imperial Coll. of Science and Tech., London). p.1-30 of "Lectures in Theoretical Physics. Volume II." Wesley E. Brittin and B. W. Downs, eds. New York, Interscience Publishers, Inc., 1960.

Considerations are given of the 3-dimensional rotation group, the homogeneous Euclidean group in 4-dimensions, the homogeneous Lorentz group, and the inhomogeneous Lorentz group. Discussions are included on reflection and rotation of Euclidean and Lorentz groups. Group theory is applied to all strongly interacting particles except e , ν , μ , and γ . All charged particles and their antiparticles correspond to representation of the 2-dimensional rotation group. If the limitations are set for 3-field interactions, then there are eight possible invariant interactions that may occur. (B.O.G.)

26256

SYMMETRY LAWS AND ELEMENTARY PARTICLE INTERACTIONS. J. J. Sakurai (Univ. of Chicago). p.31-209 of "Lectures in Theoretical Physics. Volume II." Wesley E. Brittin and B. W. Downs, eds. New York, Interscience Publishers, Inc., 1960.

Discussions on the various symmetry laws and their applications to elementary particle physics are divided according to continuous space-time transformations, parity, time-reversal, charge-conjugation, CPT theorem, γ_5 invariance, number laws, and isospin formalism. Interest is placed on the validity limits of the laws, especially at higher energies and shorter distances because some physicists have speculated on the possibility that local field theory might not be applicable to energies of a few bev or distances of the order of the Compton wavelength of the proton. Recently, attempts were made to relate symmetry laws in Lorentz space with the laws in internal space. The results are summarized as derivative and non-derivative Yukawa-type couplings. (B.O.G.)

26257

HYPERNUCLEI AND THE Λ -NUCLEON INTERACTION. B. W. Downs (Univ. of Colorado, Boulder). p.210-39 of "Lectures in Theoretical Physics. Volume II." Wesley E. Brittin and B. W. Downs, eds. New York, Interscience Publishers, Inc., 1960.

Information concerning strong interactions between lambda hyperons and nucleons, gained by phenomenological analyses of hypernuclear binding energy data, is summarized. The intrinsic properties of the Λ particle, which are relevant for the analysis of nucleon interactions, are discussed. The relationship of spin dependence in Λ -N interactions to the branching ratios in hypernuclei decay is shown. The ranges of Λ -N interactions to be expected on the basis of some meson exchange mechanisms are considered. A sketch is given of phenomenological analyses of hypernuclear binding energy data. The lectures are concluded with remarks on the effect of the presence of hard cores in Λ -N interactions. (B.O.G.)

26258

THE CLASSICAL ELECTRON. F. Rohrlich (State Univ. of Iowa, Iowa City). p.240-68 of "Lectures in Theoretical Physics. Volume II." Wesley E. Brittin and B. W. Downs, eds. New York, Interscience Publishers, Inc., 1960.

Several topics selected from classical electrodynamics

are discussed and related to the theory of the classical electron. Certain aspects of the theory are described at length although other aspects are barely mentioned or ignored completely. This discussion is presented in order to clarify vague and incorrect points found in published literature and because more is known now about the electron as an elementary particle than about any other particle with the exception of the photon. In order that a classical electron theory could qualify as a limit of quantum electrodynamics, certain similarities and analogies must be present. In particular, the difficulties in the classical theory must be analogous to those in the quantum theory and must be removable within the philosophy of renormalization. Renormalization is not discussed, but the groundwork is prepared. Topics discussed are the basic equations of the classical point electron, the definition of radiation, field and radiation reactions, Dirac's electrodynamics, self-energy and self-stress, and uniformly accelerated motion. (B.O.G.)

26259

MANY BODY PROBLEM IN QUANTUM MECHANICS.

N. M. Hugenholtz (Inst. for Advanced Study, Princeton, N. J.). p.269-330 of "Lectures in Theoretical Physics. Volume II." Wesley E. Brittin and B. W. Downs, eds. New York, Interscience Publishers, Inc., 1960.

Various methods are developed for calculating properties of the ground states and low-lying excited states of large systems of interacting particles. As applications of the methods, discussions are given of some zero-temperature properties of fermion and boson gases with repulsive interaction at low density, properties of nuclear matter, and the electron gas. Primarily, interest is placed on two formally different methods. These are the resolvent method and the Green's function method; both of which are essentially based on perturbation theory, where the interaction of the particles is considered as the perturbation. Difficulties arise when such a method is applied to cases with hard cores or Coulomb interactions. Means for the removal of such difficulties are discussed. Some of the limitations of the methods are explained. (B.O.G.)

Nuclear Properties and Reactions

26260 CERN-60-36

European Organization for Nuclear Research, Geneva. ETUDE EXPERIMENTALE DES INTERACTIONS NUCLEAIRES DE L'ORDRE DE 100 GeV. (Experimental Study of Nuclear Reactions of the Order of 100 GeV). L. Montanet. Sept. 9, 1960. 33p.

Results are given of the analysis of 116 nuclear reactions of the order of 100 Bev. The application of several rules (positive excess, energy balance, lower limit of target mass) leads to elimination of 25 complex interactions. For the other interactions, supposedly pure, the secondary particle spectra, angular distributions, incident particle energy, and inelasticity of the interaction are given. (tr-auth)

26261 CU(PNPL)-196

Columbia Univ., New York. INTERMEDIATE IMAGE PAIR SPECTROMETER MEASUREMENTS OF THE ELECTROMAGNETIC RADIATIONS FROM SOME LIGHT NUCLEI (thesis). Karl Erik Eklund. May 12, 1960. 121p. Contract AT-30-1-GEN-72. OTS.

An iron-free intermediate-image pair spectrometer was built and used to study the pair spectra of O^{16} , Ca^{40} , and Ca^{48} , and the radiations following the deuteron bombardment of aluminum and sodium with the following new re-

sults: 1. The number of magnetic monopole transitions from the 10.98-Mev (0^+) state in O^{16} is less than 10^{-4} times the number of cascade transitions through the 7.12-Mev (1^+) state, indicating that there is no unexpectedly strong interaction between the pair and nuclear fields. 2. The low yield of electric monopole transitions from the 3.8-Mev state of Ca^{48} shows that this state is not a 0^+ first-excited state, as had been expected by analogy to Ca^{40} . 3. Several γ rays between 6 and 11 Mev were observed after the deuteron bombardment of a natural sodium target and were found to be reasonably consistent with levels in Mg^{24} observed by measuring neutron groups. Transitions were observed between levels at 7.47, 8.47, 8.73, 9.82, and 10.68 Mev. (auth)

26262 IS-184

Ames Lab., Ames, Iowa.

PHOTOPRODUCTION OF CALCIUM-47. M. S. Foster, D. L. Weaver, and A. F. Voigt. Aug. 1960. 16p. Contract W-7405-eng-82. OTS.

The irradiation of highly enriched $Ca^{48}CO_3$ with a bremsstrahlung beam of maximum energy 46 Mev produced Ca^{47} with a yield of 1.1 to 3.0 μ c/mg Ca^{48} at half saturation. The half life of a sample measured through aluminum absorber to eliminate the contribution by the Sc^{47} daughter was 4.51 ± 0.02 days. By comparison with the $Cu^{63}(\gamma, n)Cu^{62}$ reaction the integrated cross section from 0 to 46 Mev for the sum of the reactions $Ca^{48}(\gamma, n)Ca^{47}$ and $Ca^{48}(\gamma, p)K^{47}$ was calculated to be 29 Mev-mbarn. The Ca^{45} content of the sample calculated to the end of the bombardment was $\sim 0.04\%$, probably the result of the $Ca^{48}(\gamma, 3n)$ and $(\gamma, p2n)$ reactions. (auth)

26263 NDA-Memo-15C-66

Nuclear Development Associates, Inc., White Plains, N. Y. STATUS OF THE NEUTRON CROSS SECTION PROGRAM, AS PRESENTED AT THE JANUARY, 1955 MEETING OF THE AEC NUCLEAR CROSS SECTION ADVISORY GROUP. H. Goldstein. Feb. 23, 1955. Decl. Aug. 5, 1960. 23p. Contract AT(30-1)-862. OTS.

Some information on neutron cross-section measurement programs presented in the Jan. 1955 meeting of the AEC NCSAG is informally given. It was felt that some of the data would be of immediate interest to people working in shielding and reactors. (W.D.M.)

26264 NP-9232

Illinois. Univ., Urbana.

A STUDY OF THE PROPERTIES OF RADIOACTIVE NUCLEI BY OPTICAL ORIENTATION. Final Report [for Period] November 1959-July 1960. 5p. Contract AF49(638)-781.

Apparatus was designed and constructed for the determination of the spins and moments of Cd^{107} and Cd^{109} . The technique employed was essentially the well-known optical double-resonance method. The technique required a cadmium spectral lamp, a cadmium scattering bulb, a photo detector, controlled magnetic fields, and suitable polarizing optics. (W.D.M.)

26265 ORNL-2954

Oak Ridge National Lab., Tenn.

TABLE OF ELECTRON WAVE FUNCTIONS AT THE NUCLEAR SURFACE. C. P. Bhalla and M. E. Rose. Oct. 3, 1960. 203p. Contract W-7405-en[g]-26. OTS.

In nuclear beta decay, the differential energy spectrum of the beta particles depends on the electron radial functions which are evaluated at the nuclear surface, as well as on the nuclear matrix elements which are considered as adjustable parameters. The nucleus was considered to be a sphere of a uniform charge distribution with the nuclear

radius $1.2A^{1/3} \cdot 10^{-13}$ cm. Screening was neglected. Electronic radial functions evaluated at the nuclear surface $x = \pm 1$, the Fermi function F_0 , and $\sin(\eta_x - \eta_{-x})$ are given. (W.D.M.)

26266 ORNL-2983(p.1-7)

Oak Ridge National Lab., Tenn.

NUCLEAR CHEMISTRY. E. Eichler, J. W. Chase, et al.

The beta and gamma radiations of 21-hr ^{133}I were investigated by single-crystal and multicrystal scintillation spectrometers, and a scheme is proposed for the energy levels of Xe^{133} . The level scheme of Ge^{74} was obtained by means of single-crystal and multicrystal beta- and gamma-ray spectrometry using sources of Ga^{74} and As^{74} . The angular correlation for the 0.60-0.60-Mev cascade was measured. Both beta- and gamma-ray single-crystal measurements and gamma-beta and gamma-gamma coincidence experiments were performed on the decay of ^{132}I . Also, gamma-gamma angular correlations were measured for all the prominent gamma rays. This information has led to a level scheme in Xe^{132} involving excited states at 0.673, 1.448, 1.97, 2.10, 2.40, 2.59, and 2.84 Mev with spin assignments of 2, 4, 3, and 4 for the first four of these. A study of 2.7-hr Pm^{150} established that the most energetic beta ray, at 3.16 ± 0.11 Mev, decays to the first excited state of Sm^{150} at 0.333 Mev. A partial decay scheme based on beta-gamma coincidence spectrometry was formulated with excited states in Sm^{150} at 0.333, 1.18, 1.66, and 2.08 Mev. The measurement of the neutron-absorption cross sections of Ce^{141} and Ce^{144} by the activation method is in progress. Separation of the 5.9-hr Pr^{145} daughter of the 3-min Ce^{145} produced by the (n, γ) reaction on Ce^{144} from the associated cerium isotopes was accomplished by the extraction of tetravalent cerium with di(2-ethyl-hexyl)-phosphoric acid in n-heptane. Preliminary results of several irradiations of Ce^{144} in the LTR indicate an effective neutron cross section of $(6 \pm 2) \times 10^{-24}$ cm²/atom. Flux depressions in the vicinity of and within infinite cadmium slabs were calculated using the SNG reactor code on the IBM-704 computer at K-25. These results are pertinent to burnout calculations concerning cadmium filters during long irradiations. An upper limit of 0.1 barn was set for the formation cross section of the 25-sec isomer of Po^{211} from Po^{210} for thermal reactor neutrons. An upper limit of about 7×10^5 years was obtained for the half life of Bi^{208} by measuring the disintegration rate and measuring qualitatively the $\text{Bi}^{208}/\text{Bi}^{209}$ ratio; this value is consistent with an approximate estimate of 7.5×10^5 years by C. H. Miller and co-workers at Chalk River. A value of 870 barns was determined for the fission resonance integral of U^{233} from analyses of three fission products: Sr^{88} , Mo^{99} , and Ba^{140} . This value may be compared with two values, 900 and 820 barns, calculated from available resonance data. Work on electron depolarization by scattering and the effect of multiple scattering on scattering asymmetry, along with changes in experimental equipment, will allow the use of weaker sources in beta-ray polarization measurements. (auth)

26267 TID-6458

University of Notre Dame, Notre Dame, Ind.

RADIOACTIVE DECAY OF Pm^{143} , Pm^{144} , AND Pm^{146} .

E. G. Funk, Jr., J. W. Mihelich, and C. F. Schwerdtfeger. [1960]. 43p. Contract [AT(11-1)-498]. OTS.

The decay of Pm^{143} , Pm^{144} , and Pm^{146} was studied. Results on the electron-capture decay of Pm^{143} and Pm^{144} are in agreement with previously reported results. The results of gamma-gamma directional-correlation measurements are consistent with the spin assignments for the Nd^{144} lev-

els made by Ofer. Pm^{146} ($T_{1/2} \sim 710$ days) was found to decay both by beta emission to a level of 749 kev in Sm^{146} and by electron capture to levels of 453 and 1198 kev in Nd^{146} . The percentage branchings were 35%, 35%, and 30%, respectively. Gamma-ray transitions of 453 and 745 kev in cascade in Nd^{146} and 749 kev in Sm^{146} were observed. The end-point energy for the beta-decay branch was measured to be 779 kev. The beta spectrum appeared to have an allowed shape but the experimental data are not precise enough to rule out a forbidden shape. Directional-correlation and internal-conversion coefficient measurements were most consistent with a 3+ assignment for the 1198 kev level in Nd^{146} . A 2+ assignment was possible, but less likely, since the cross-over transition was absent or extremely weak. (auth)

26268 TID-6476

Purdue Univ., Lafayette, Ind. and Purdue Research

Foundation, Lafayette, Ind.

NUCLEAR SPECTROSCOPY AND THE APPLICATION OF RADIOISOTOPES TO THE STUDY OF REACTION KINETICS. Progress Report No. 2 [for] August 1, 1959-July 31, 1960. D. C. Conway. 28p. Includes Appendix A: THE L/K-CAPTURE RATIO AND EL/EK FOR Ar^{37} . A. G. Santos-Ocampo and D. C. Conway. Contract AT(11-1)-694. OTS.

Progress is reported in the investigation of L/K capture. The counting system was modified and the L/K capture ratio of Ar^{37} was measured. The attempt to determine the β spectrum of $\text{Re}^{187}\text{O}_3\text{Cl}$ in a proportional-counter spectrometer failed owing to the poison effect which was 100 times as severe as expected. Measurements on Si^{32} are nearly complete. Construction and testing of an apparatus for kinetic studies in which ethyl iodide pyrolysis is to be carried out are reported. (J.R.D.)

26269 TID-6526

Minnesota. Univ., Minneapolis. School of Physics.

THREE BODY NUCLEAR PROBLEM WITH REPULSIVE CORE FORCES. Carl Werntz. 1960. 20p. OTS.

A variational calculation of the binding energy of the triton was carried out using the Gartenhaus potential. The results indicate that this potential leads to an unbound ground state of the three-nucleon system; this result is attributable to the even-parity tensor potential which is relatively large in magnitude compared to the weakly attractive even-parity central potential. Since this property is also a characteristic of the Signell-Marshak potential, it too should lead to an unbound triton. (auth)

26270 TID-6575

Michigan. Univ., Ann Arbor. Coll. of Literature, Science, and the Arts.

THE UNIVERSITY OF MICHIGAN CYCLOTRON. Progress Report. W. C. Parkinson. July 1960. 23p. Contract AT(11-1)-275. (UMRI-2842-10-P). OTS.

Energy level structure is reported for Mg^{25} , Mg^{26} , Na^{24} , and Al^{28} . Proton polarization was measured in the reaction $\text{Be}^9(d,p)\text{Be}^{10}$ at a deuteron energy of 7.8 Mev for the ground-state reaction. The development of solid-state detectors, one a rectifying-barrier detector and the other a parallel plate ionization chamber, is reported. An extension of the deuteron stripping theory is discussed and compared to results obtained by using the Butler theory. (C.J.G.)

26271 UCRL-5226(Rev.)(Pt. 1, Vol. 1)

California: Univ., Livermore. Lawrence Radiation Lab. TABULATED NEUTRON CROSS SECTIONS, PART 1. 0.001-14.5 MEV. VOLUME 1. ^1H - ^{22}Ti . Robert J.

Howerton. Oct. 1959. 409p. Contract W-7405-eng-48. OTS.

Tables of neutron total, elastic, inelastic, scattering, and absorption cross sections are presented for the elements hydrogen through titanium at 0.001 to 14.5 Mev. (C.J.G.)

26272 UCRL-5226(Rev.)(Pt. 1, Vol. 2)
California. Univ., Livermore. Lawrence Radiation Lab.
TABULATED NEUTRON CROSS SECTIONS. PART I.
0.001-14.5 MEV. VOLUME 2. ^{23}V - ^{20}Sn . Robert J.
Howerton. Oct. 1959. 344p. Contract W-7405-eng-48.
OTS.

Tables of neutron total, elastic, inelastic, scattering, and absorption cross sections are presented for the elements V through Sn at 0.001 to 14.5 Mev. (C.J.G.)

26273 UCRL-9275
California. Univ., Berkeley. Lawrence Radiation Lab.
THE LIQUID-DROP MODEL OF FISSION: EQUILIBRIUM
CONFIGURATIONS AND ENERGETICS OF UNIFORM
ROTATING CHARGED DROPS (thesis, part I). John R.
Hiskes. June 16, 1960. 56p. Contract W-7405-eng-48.
OTS.

The problem of finding the equilibrium configurations of uniform rotating-charged liquid drops is considered. An analytic treatment is given based on a parametric expansion for small ellipsoidal distortions about a sphere. This treatment is applied to finding the ground-state configurations and the saddle-shaped configurations leading to fission as functions of charge and angular momentum of the drop. A variation-iteration method for generating the configurations of equilibrium is described. The method is applied to finding the configurations of equilibrium of axially symmetric drops over the range $0 \leq x \leq 1$ and $0 \leq y \leq 0.5$, where x is the ratio of the Coulomb energy to twice the surface energy for a sphere and y is the ratio of the rotational energy to the surface energy for a sphere. The energetics of these configurations are calculated; the fission thresholds are calculated in the range of applicability of the parametric expansions. (auth)

26274 UCRL-9304
California. Univ., Berkeley. Lawrence Radiation Lab.
THE EFFECT OF ANGULAR MOMENTUM ON FISSION
PROBABILITY (thesis). John Gilmore. July 1960. 84p.
Contract W-7405-eng-48. OTS.

A nuclear emulsion technique was used to determine total fission cross sections in the following heavy-ion bombardments: ($\text{C}^{12} + \text{Tm}^{169}$, $\text{O}^{16} + \text{Ho}^{165}$), ($\text{O}^{16} + \text{Tm}^{189}$, $\text{Ne}^{20} + \text{Ho}^{165}$), ($\text{C}^{12} + \text{Re}^{185}$, $\text{O}^{16} + \text{Ta}^{181}$), and ($\text{O}^{16} + \text{Re}^{185}$, $\text{Ne}^{20} + \text{Ta}^{181}$). Each pair of bombardments resulted in the same compound nucleus, and excitation energies could be made equal in the two cases by adjustment of bombarding energies. The ratio of the fission cross section to a calculated compound nucleus formation cross section, σ_f/σ_c , was taken as a measure of fission probability in each bombardment. In most bombardments a larger value of σ_f/σ_c for the heavier ion was associated with a higher angular momentum brought in by that ion. This correlation supported liquid-drop-model calculations which predict that fission should be enhanced because of an effect of angular momentum in lowering the fission barrier. Indirect effects of angular momentum on fission probability through hindrance of neutron and charged-particle emission were taken into account. Values of σ_f/σ_c in the bombardments with full-energy Ne^{20} ions were unexpectedly low. This observation led to consideration of the possibility, suggested by liquid-drop calculations, that compound nucleus formation would be forbidden for very large angular momenta. The effects of including polarization and target nucleus deformation in calculations of σ_c and angular momentum are discussed briefly. (auth)

26275

NUCLEAR FORCES AND THE PROPERTIES OF NUCLEAR MATTER. S. A. Moszkowski and B. L. Scott (Univ. of California, Los Angeles). *Ann. Phys. (N.Y.)* **11**, 65-115 (1960) Sept.

The application of the Brueckner theory to the nuclear many-body problem can be greatly simplified if the two-nucleon interaction (for any given state and relative momentum is separated into a short range part v_s) and a long range part v_l . The cut is made such that v_s alone gives no phase shift for free particle scattering. If the separation is made in this way, then the presence of nuclear matter, as manifested by the Pauli principle, has only a small effect on the two-particle wave function at short distance. On the other hand, the Pauli principle drastically reduces the induced correlations owing to v_l . In fact, v_l is the first approximation to the effective interaction in nuclear matter. This procedure permits one to systematically expand the effective interaction in terms of t_s , the reaction operator for free particles caused by v_s alone. The contribution of all first- and second-order terms to the binding energy of extended nuclear matter was calculated numerically. Most of the work was done using a central spin-independent two-body interaction containing a hard core of radius 0.4 fermi followed by an attractive exponential well with parameters chosen to give infinite scattering length and intrinsic range 2.5 fermis. If the potential is assumed to act only in S-states, a minimum energy of -12 Mev per particle is obtained at a density corresponding to a nuclear radius $1.0 \text{ A}^{1/3}$ fermis. The largest of the second-order terms contributes only 5.4 Mev to the energy per particle at this density (as compared to -42 Mev for the first-order term) and the other second-order terms much less. Thus the expansion appears to converge fairly rapidly. The effect of changes in the well parameters was investigated. This method was applied to interactions used by Gomes et al., Brueckner and Gammel, and Tagami, and these results compared with some of those obtained by the above. (auth)

26276

APPLICATION OF THE STATISTICAL MODEL TO MULTIPLE PHOTONUCLEAR PROCESSES: Sergio Costa (Università. Turin). *Atti accad. nazl. Lincei. Rend., Classe sci. fis., mat e nat.* **28**, 179-82(1960) Feb. (In Italian)

The experimental cross sections for photonuclear reactions in S^{32} are compared with the theoretical cross sections obtained from the evaporation model. The results for (γ, np) and (γ, xn) , where x indicates more than one neutron, are not in good agreement. (J.S.R.)

26277

THE PHOTONEUTRON CROSS SECTION OF ^9Be IN THE INTERMEDIATE ENERGY RANGE. H. H. Thies, B. M. Spicer, and J. E. E. Baglin (Univ. of Melbourne). *Australian J. Phys.* **12**, 21-9(1959) Mar.

The photoneutron cross section of Be^9 was measured in the region from 6.5 to 18 Mev, using filtered bremsstrahlung radiation from an 18-Mev synchrotron. The integrated cross section is in agreement with an earlier experiment, but increased resolution showed a more complex shape, with sharp maxima at 11.25 ± 0.2 and 13.25 ± 0.2 Mev. The significant features of the cross section are discussed and compared with the level scheme as it is known at present. (auth)

26278

THE ENERGY SPECTRUM OF PROTONS FROM THE $^7\text{Be}(d,p)^6\text{Be}$ REACTION. R. H. Spear (Univ. of Melbourne). *Australian J. Phys.* **12**, 99-102(1960) Mar.

The reaction $\text{Be}^7(d,p)\text{Be}^8$ was studied in order to determine the energy spectrum of the protons. The target was prepared by evaporating a solution of Be^7 in HCl onto a gold foil. Spectra were obtained at angles of 13, 87, and 268°. The number of protons per 400-kw interval was plotted as a function of proton energy and Be^8 excitation energy. (M.C.G.)

26279

CALCULATION OF THE HYPERFINE STRUCTURE CONSTANTS OF THE ATOMS N^{14} AND O^{17} BY THE METHOD OF CONFIGURATION INTERACTION. Nadine Bessis-Mazloum and Hélène Lefebvre-Brion (Centre de Mécanique Ondulatoire Appliquée, Paris). Compt. rend. **251**, 648-50 (1960) Aug. 1. (In French)

The hyperfine magnetic constants of N^{14} and O^{17} are calculated by introducing, for the representation of the basic electron state, a mixture with the basic configuration of the excited configurations corresponding to the excitation modes $2s \rightarrow 3s$ and $2p \rightarrow 3p$ and by utilizing as atomic orbitals some linear orthogonal combinations of Slater orbitals with the usual values of the parameters. The calculation, with the same function, of the electric field gradient created in the nucleus by the electrons permits a theoretical estimation of the nuclear electric quadrupole moment of O^{17} from the experimental data. (tr-auth)

26280

INELASTIC SCATTERING OF ELECTRONS WITH EXCITATION OF THE GIANT RESONANCE OF OXYGEN-16. Didier Isabelle and Georges Bishop (Laboratoire de l'Accélérateur Linéaire, Orsay, France). Compt. rend. **251**, 697-9(1960) Aug. 1. (In French)

The inelastic scattering of electrons by oxygen was studied by focusing an electron beam on a water target. The energy spectra of the scattered electrons were analyzed with a double-focusing magnetic spectrometer and a Cherenkov counter. Typical spectra obtained at $\theta = 60^\circ$ and $E_0 = 100$ Mev are given. The spectra obtained for $E_0 = 83$ and 100 Mev and corrected for the thickness of the target are shown. (J.S.R.)

26281

PRELIMINARY STUDY OF NUCLEAR REACTIONS PROVOCKED BY 200-MEV NEON-20 IONS IN IONOGRAPHIC EMULSIONS. Raymond Pfohl, Christiane Gegauff, and Jean-Pierre Lonchamp. Compt. rend. **251**, 712-14(1960) Aug. 1. (In French)

The reactions produced by the interaction of Ne^{20} ions with the constituents of ionographic emulsions were studied. Emulsions of the Ilford G₅ and C₂ types were used. The interaction cross sections as a function of the energy of the incident ion at the moment of collision were determined for all the stars and for stars with 3, 4, 5, and 6 branches. The differential cross sections were also determined as a function of energy. The percentage of heavy ions ($Z > 2$) emitted during the reactions studied was $40 \pm 2\%$. The range of the heavy ions was determined, and it was shown that the angular distribution has a very strong collimation forward. (J.S.R.)

26282

MEAN LIFE OF THE FIRST EXCITED STATE OF Al^{25} . Serge Gorodetzky, Raymond Richert, Robert Manquenouille, and Albert Knipper (Institut de Recherches Nucléaires, Strasbourg). Compt. rend. **251**, 944-6(1960) Aug. 17. (In French)

The mean life of the first excited level at 450 keV of Al^{25} was measured in delayed γ - γ coincidences following the

$\text{Mg}^{24}(p,\gamma)\text{Al}^{25}$ reaction. It was found to be $T_{1/2} = (1.88 \pm 0.10) \times 10^{-9}$ sec. (tr-auth)

26283

SPECTROMETRY OF TIME-OF-FLIGHT OF NEUTRONS FROM THE (p,n) REACTION ON VANADIUM. René Ballini, Yves Cassagnou, Christiane Lévi, and Lily Papineau (Centre d'Etudes Nucléaires, Saclay, France). Compt. rend. **251**, 947-9(1960) Aug. 17. (In French)

The time selector associated with the pulsed beam of the 5-Mev Van de Graaff at Saclay was utilized to separate several groups of neutrons from the $V(p,n)$ reaction, to measure their energy differences, and to determine their angular distribution. (tr-auth)

26284

HIGH RESOLUTION SPECTROSCOPY USING p-n JUNCTIONS, APPLIED TO THE STUDY OF NUCLEAR REACTIONS: $\text{O}^{18}(d,\alpha)\text{N}^{16}$ REACTION. Georges Amsel and Olgierd Smulkowski (École Normale Supérieure, Paris). Compt. rend. **251**, 950-2(1960) Aug. 17. (In French)

The particular problems which the utilization of silicon p-n junctions pose during the detection of particles produced by nuclear reactions are considered. A system for the protection of the junction against secondary ions created by the beam is described. These methods of spectroscopy were applied to the simultaneous study of the reactions $\text{O}^{18}(d,\alpha)\text{N}^{16}$ and $\text{O}^{16}(d,\alpha)\text{N}^{14}$. Some groups of α particles 70 keV apart were separated. (tr-auth)

26285

CIRCULARLY POLARIZED ANGULAR CORRELATIONS IN THE CASE OF EUROPIUM-152. Jean Berthier, Pierre Debrunner, Michel Lambert, and Roland Lombard. Compt. rend. **251**, 1065-7(1960) Aug. 29. (In French)

The experimental apparatus for the study of the circularly polarized angular correlation of the allowed transition of Eu^{152} consists of an electromagnet with cylindrical symmetry and forward scattering with the direction of the magnetic field changed every 5 min. The hypotheses for the calculation of the efficiency of the electromagnet as analyzer of the circular polarization of a beam of photons are indicated. The anisotropy of Eu^{152} was measured at $A = 0.106 \pm 0.032$. The theoretical expression for A was determined as a function of the matrix elements. If the K selection rule is accepted and if it is assumed responsible for the large value of $\log ft$ and the strong $\beta\gamma$ anisotropy of the forbidden transition, then it is suggested that the matrix elements with $\lambda = 1$ predominate. (J.S.R.)

26286

"NON-PHYSICAL" THRESHOLDS IN THE PERTURBATION THEORY. O. I. Zav'yalov (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. **133**, 64-7(1960) July 1. (In Russian)

Some cases of continuous spectra cannot be described by simple physical analysis and are considered to be "non-physical" anomalous thresholds. A mathematical analysis was made for the purpose of formulating sufficient conditions for the anomalous threshold of arbitrarily complex diagrams. (R.V.J.)

26287

ANALYSIS OF THE CORRELATION COEFFICIENT OF THE UNCERTAINTY FUNCTION $X(t) = 1$. APPLICATION TO THE STUDY OF THE DECAY LAWS OF RADIOELEMENTS. G. Landaud and Cl. Mabboux (Laboratoire de Physique Corpusculaire, Caen, France). J. phys. radium **21**, 615-16(1960) July. (In French)

The study of the correlation coefficient, $C(h) = E(X(t) \cdot$

$X(t + h)$, as a function of the delay h permits the deduction of the decay law of any radioisotope. A correlator permitting the analysis of $C(h)$ from the particles emitted by the radioisotopes is described. The delay circuit of the correlator permits the continuous analysis of $C(h)$ delays from 3×10^{-6} to 2×10^{-3} sec. The precision of the measurements was determined, and a stationary Poisson distribution of the pulses from the particles emitted by Co^{60} is analyzed. (J.S.R.)

26288

REACTIONS OF IRON-54 WITH ALPHA-PARTICLES.

Shigeo Tanaka, Michiaki Furukawa, Shiro Iwata, Masuo Yagi, Hiroshi Amano, and Takashi Mikumo (Tokyo Univ.). *J. Phys. Soc. Japan* **15**, 1547-51(1960) Sept. (In English)

Excitation functions for the (α, p) , (α, n) , (α, pn) , $(\alpha, 2n)$, $(\alpha, p2n + \alpha, 3n)$, $(\alpha, \alpha n)$, $\alpha, \alpha pn$, and $(\alpha, \alpha 2n)$ reactions on Fe^{54} were measured by the activation method using a "stacked-foil" technique. The α -particle energies ranged from 10 to 40 Mev. The predominance of proton emission over neutron emission was observed. The ratios of $\sigma(\alpha, p)/\sigma(\alpha, n)$ and $\sigma(\alpha, pn)/\sigma(\alpha, 2n)$ in the region of maximum yield were found to be 3.4 and 60, respectively. The ratio of $\sigma(\alpha, \alpha pn)/\sigma(\alpha, \alpha 2n)$ at 40 Mev was about 180. A small "knee" was observed at the incident α -particle energy of about 20 Mev in the excitation function for the $(\alpha, 2n)$ reaction. The total reaction cross section was found to agree with the value calculated from continuum theory for a nuclear radius constant r_0 of 1.7×10^{-13} cm, assuming a nuclear square-well potential. (auth)

26289

GAMMA-RAYS FROM THE 7.56 Mev LEVEL IN O^{16} .

Tatsuo Tabata and Kotoyuki Okano (Kyoto Univ.). *J. Phys. Soc. Japan* **15**, 1552-5(1960) Sept. (In English)

The γ rays from the $\text{N}^{14}(p, \gamma)\text{O}^{16}$ reaction at the $E_p = 278$ -kev resonance, corresponding to the 7.56-Mev level in O^{16} , were studied with a large crystal scintillation spectrometer. The direct ground-state transition γ ray of about 3% in intensity of the total decay was found to exist in addition to the three known cascade lines. Angular distributions of these γ rays were all isotropic, supporting the $J\pi = 1/2^+$ assignment to the resonance state. The transition strength (radiation width in units of Weisskopf single-particle width) of the direct ground-state transition E1 γ ray was calculated to be $|M|^2 = 4.15 \times 10^{-6}$, which was by a factor of 10^{-4} smaller than the normal E1 transition strength found in light nuclei. Other transitions in O^{16} were estimated to be of normal strength when compared with Wilkinson's estimation. (auth)

26290

LOWER EXCITED STATES IN P^{29} FROM THE $\text{Si}^{28}(p, \gamma)\text{P}^{29}$ REACTION. Kotoyuki Okano, Tatsuo Tabata, Kyue Fukuda, and Jiro Muto (Kyoto Univ.). *J. Phys. Soc. Japan* **15**, 1556-64(1960) Sept. (In English)

The γ rays from the $\text{Si}^{28}(p, \gamma)\text{P}^{29}$ reaction at the $E_p = 369$ -kev resonance were studied with a large NaI(Tl) crystal scintillation spectrometer. The resonance state, corresponding to the 3.116 ± 0.012 -Mev fourth excited state in P^{29} , was found to decay by $(74 \pm 4)\%$ to the first excited state at 1.384 ± 0.008 Mev and by $(26 \pm 4)\%$ to the second excited state at 1.961 ± 0.013 Mev, which decays predominantly to the ground state. From the angular distribution measurements of each γ -ray line, spins and parities as follows: 1.38 Mev (1st), $J = 3/2^+$; 1.96 Mev (2nd), $J = 5/2^+$; and 3.12 Mev (4th), $J = 5/2^+$. These assignments are all consistent with the known character of the corresponding levels in the mirror nucleus Si^{28} , and are also in agreement with the theoretical predictions. From the precise γ -

ray energy measurements, the Q value of this reaction was estimated as 2.760 ± 0.013 Mev, which is by about 36 kev larger than the published value based on the β -ray end-point energy measurement. The resonance strength $(2J + 1)\Gamma_p\Gamma_\gamma/(\Gamma_p + \Gamma_\gamma)$ was found to be $(4.7 \pm 0.8) \times 10^{-3}$ ev. (auth)

26291

ON THE THEORY OF MULTIPLE COULOMB EXCITATION WITH HEAVY IONS. Kurt Alder and Aage Winther (Federal Inst. of Tech., Zurich and Univ. of Copenhagen).

Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. **32**, No. 8, 1-71(1960). (In English)

Formulas and tables are given for the evaluation of multiple Coulomb excitation cross sections of rotational and vibrational states. For other cases, general calculational procedures were developed, and these are illustrated through examples. For the larger part of the work, the collision time was assumed to be short compared to the nuclear period. The investigation was furthermore simplified by an approximate treatment of the dependence of the cross section on the deflection angle of the projectile. The accuracy of the approximations is also discussed. (auth)

26292

PAIRING PLUS LONG RANGE FORCE FOR SINGLE

CLOSED SHELL NUCLEI. L. S. Kisslinger and R. A.

Sorensen [(Inst. for Theoretical Physics, Copenhagen)].

Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. **32**, No. 9, 1-82(1960). (In English)

The low-energy properties of nuclei were calculated, using a model which combined certain important features of the unified nuclear model and the independent-particle model with a two-body residual interaction. The residual interaction used had a pairing force and a long-range part. Calculations were made for nuclei with a major closed proton or neutron shell, $A > 48$, for various values of the two-strength parameters, using single-particle levels taken from experiment. In each region, the calculated energy levels and spins agreed in considerable detail with systematic experimental data. In addition, the even-odd- A mass difference, the electromagnetic transition rates, and other properties were calculated and compared to experiment. The approximate $1/A$ dependence of the parameters was consistent with a volume force. (auth)

26293

INTERNAL CONVERSION COEFFICIENTS OF E2 TRAN-

SITIONS. B. N. Subba Rao (Tata Inst. of Fundamental

Research, Bombay). *Nuovo cimento* (10) **17**, 189-97(1960) July 16. (In English)

A survey and analysis of all available data on internal conversion coefficients of pure E2 ($2^+ \rightarrow 0^+$) transitions is presented. The results indicate the possibility of the internal conversion coefficients depending on the deformation of the nucleus. (auth)

26294

COMPARISON OF THE β - α ANGULAR CORRELATIONS

IN Li^8 AND B^8 . M. E. Nordberg, F. B. Morinigo, and C. A.

Barnes (California Inst. of Tech., Pasadena). *Phys. Rev. Letters* **5**, 321-3(1960) Oct. 1.

Following the allowed β decay of unoriented nuclei, which are uncorrelated in angle with the β rays, forbidden effects may produce correlations of the form $1 + B \cos^2\theta$, where the coefficient B depends on the details of the matrix elements involved. As a possible test of the conserved vector current (CVC) theory, various suggestions have been made to measure the difference, δ , of the B coefficients in the

β - α correlations of the two decays: $\text{Li}^8(\beta\bar{\nu})\text{Be}^{8*}(\alpha)\text{He}^4$ and $\text{B}^8(\beta\bar{\nu})\text{Be}^{8*}(\alpha)\text{He}^4$. Preliminary results, $\delta \approx (0.003 \pm 0.004) W_\beta$, conflicted with the Bernstein-Lewis prediction and indicated that either the failure of the CVC theory or that of the value assumed for the M1 matrix element was too large. In view of other calculations, δ was recalculated with improved statistical accuracy and with special emphasis on reducing systematic errors. The new value was found to be $\delta = (0.0069 \pm 0.0008) W_\beta$, in agreement with the CVC theory. (B.O.G.)

26295

FT VALUE OF O^{14} AND THE UNIVERSAL FERMI INTERACTION. R. K. Bardin, C. A. Barnes, W. A. Fowler, and P. A. Seeger (California Inst. of Tech., Pasadena). *Phys. Rev. Letters* **5**, 323-6(1960) Oct. 1.

The experimentally observed near equality of the coupling constants in beta and muon decays has suggested that all the "weak interactions" proceed by a universal Fermi interaction. It is of interest to establish the degree to which the coupling constants G_V for the vector β -decay and G_μ for the muon decay are equal. The precision with which G_μ is known has improved considerably due to more accurate measurements of the muon mean lifetime and mass. To determine G_V more accurately the ft value was measured for the $0^+ \rightarrow 0^+ \beta$ transition in $\text{O}^{14}(\beta^-\bar{\nu})\text{N}^{14*}$. After a total correction of +0.289% for nuclear electromagnetic form factors, competition from K capture, and electron screening, the ft value is 3069 ± 13 sec. The corrected ft value yields $G_V = (1.416 \pm 0.003) \times 10^{-48}$ erg cm³. If this value is adopted for G_μ , then, without radiative corrections, the calculated mean lifetime of the muon becomes 2.250 ± 0.010 μ sec, which is $1.8 \pm 0.5\%$ greater than the mean of the observed lifetime, 2.210 ± 0.003 μ sec. (B.O.G.)

26296

ISOTOPIC SPIN CONSERVATION AND BETA-GAMMA CIRCULAR POLARIZATION CORRELATION IN Ar^{41} AND Sc^{46} . Stewart D. Bloom, Lloyd G. Mann, and John A. Miskel (Univ. of California, Livermore). *Phys. Rev. Letters* **5**, 326-9(1960) Oct. 1.

Several experiments have indicated that in Sc^{44} , Sc^{46} , and Mn^{52} beta decay the isotopic spin conservation law is poorly obeyed. Measurements of β - γ circular polarization correlation for Ar^{41} , whose decay is characterized by $\Delta J = 0$ and $\Delta T \neq 0$, were made by the method of Schopper, Boehm, and Wapstra. These decay characteristics are necessary to identify the presence of a Fermi component in β decay with a violation of the isotopic spin conservation law. The question is complicated by the possibility that meson exchange phenomena might effectively introduce isotopic-spin-nonconserving impurities into the β interaction. The measurements for Ar^{41} , as well as Sc^{46} , were interpolated between comparison runs on Na^{22} and Co^{60} . The experimental asymmetry parameters as a function of Fermi to Gamow-Teller matrix element ratio are given for Ar^{41} and Sc^{46} . The isotopic spin assignments are approximate because of impurities introduced in the nuclear wave functions due to Coulomb effects. (B.O.G.)

26297

ORBITAL ELECTRON CAPTURE BY THE NUCLEUS. R. Bouchez and P. Depommier (Université, Grenoble, France). *Repts. Progr. in Phys.* **23**, 395-452(1960).

The general properties of orbital electron capture are reviewed. Energetic considerations, radiations associated with capture (x-rays and Auger electrons), and their experimental investigation are discussed. Considering the new results on β interaction, formulas for transition prob-

abilities for any order of forbiddenness were calculated by the spherical tensor method and using the two-component neutrino theory with (V, A) interaction. L/K ratios were computed from the formulas, using the bound electron wave functions given by Brysk and Rose. Theoretical results were compared with the experimental data and the agreement is fairly good. K/ β^+ ratios were computed using Dzelepov's tables for the β^+ spectrum and Brysk's and Rose's functions for the K electron. For allowed and "unique" transitions the calculated values agree with experiment. (auth)

26298

^3He INDUCED REACTIONS. D. A. Bromley and E. Almquist (Atomic Energy of Canada Ltd., Chalk River, Ont.). *Repts. Progr. in Phys.* **23**, 544-629(1960).

A review is presented of the results obtained from studies of He^3 induced nuclear reactions prior to June 1959. Following a brief historical survey including range-energy, energy loss, and stopping power data as well as a reaction Q value tabulation, the experimental results are first presented in terms of their relevance to determination of the reaction mechanisms involved. This is followed by a discussion of the use of He^3 in nuclear spectroscopy. The available He^3 reaction data are summarized according to the target nuclide involved. Numerous figures illustrating excitation curves, spectra, and angular distributions are included. Experiments are suggested which emphasize a very great scope remaining for experimental work with low-energy He^3 accelerators. A bibliography covering all publications on He^3 reactions prior to June 1959 and including selected papers on experimental techniques as well as on the production and handling of He^3 in accelerators is appended. (auth)

26299

REDUCED WIDTHS OF INDIVIDUAL NUCLEAR ENERGY LEVELS. A. M. Lane (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Revs. Modern Phys.* **32**, 519-66(1960) July.

The theoretical prediction of widths of nuclear energy levels is discussed. The expressions for widths derived from the shell model and the strong coupling version of the Bohr-Mottelson mode are presented. The observed level widths of nuclei of mass number < 40 were compiled and theoretically discussed. Reduced width amplitudes in terms of expansion coefficients and interpretations of the expansion coefficients with the shell model and the rotational model are discussed. Experimental values of reduced widths of resonance levels in light nuclei for normal and nonnormal parity states are given. These widths of unbound levels were obtained by measuring excitation curves of resonance reactions. Widths for bound levels were obtained from measurements of yields in stripping reactions or, in the case of photon channels, from Coulomb excitation. (M.C.G.)

26300

HEAVY NUCLEUS FISSION WITH EMISSION OF LONG-RANGE α PARTICLES. N. A. Perfilov, Yu. F. Romanov, and Z. I. Solov'ev. *Uspekhi Fiz. Nauk* **71**, 471-83(1960) July. (In Russian)

An analysis was made of complex heavy-nucleus fission in which three charged particles are emitted. The three-particle event is rare in the binary fission background. A third long range α particle was observed in a photographic film saturated with uranium salt and irradiated by thermal neutrons. The probabilities of complex fission and the energy and angular distributions of the long range α parti-

cle are discussed, as well as the energy spectrum of triple-fission fragments and the hypothesis on triple-fission mechanisms. 31 references. (R.V.J.)

26301

ELECTRON POLARIZATION IN ALLOWED BETA-TRANSITIONS WITH COULOMB CORRECTIONS. G. Felsner and M. E. Rose (Oak Ridge National Lab., Tenn.). *Z. Physik* 159, 505-15(1960). (In English)

The polarization of electrons was calculated with coulomb-field-wave functions for the electron and two-component theory for the neutrino for Fermi, Gamow-Teller, and mixed transitions. The Coulomb corrections in a complete polarization change nothing but the direction. For pure Fermi transition, by consideration of the Coulomb corrections it is found that the electron polarization is a unit vector antiparallel to the pulse of the neutrino in the rest system of the electron. In pure Gamow-Teller transitions the electron polarization was obtained as a function of the polarization degree and the "degree of alignment" of the initial nuclei. It is found, for example, for completely oriented nuclei in Co^{60} ($J' = J - 1$) that the electron polarization is independent of the neutrino direction. In mixed transitions ($J' = J$) and completely oriented nuclei, complete polarization of the electron is found only in the neutron case ($J' = J = \frac{1}{2}$). Unique first forbidden Gamow-Teller transitions were also considered and no complete electron polarization was found even when the initial nuclei were polarized to 100%. In an appendix, the calculation for unique forbidden transitions is given completely (as example of the application of Racah algebra). (tr-auth)

26302

PRESENT STATUS AND PROBLEMS IN THE THEORY OF BETA DECAY. J. Hans D. Jensen (Univ. of Heidelberg, Ger.). p.331-65 of "Lectures in Theoretical Physics. Volume II." Wesley E. Brittin and B. W. Downs, eds. New York, Interscience Publishers, Inc., 1960.

The history of β -decay theory is reviewed. The history of the development of the neutrino hypothesis is not discussed, but the existence of the neutrino is assumed in building the experimental properties of the presently accepted theory. The effect of the nuclear Coulomb field on the electronic wave function is discussed in an appendix. (B.O.G.)

Particle Accelerators

26303 AERE-R-3312

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

7 GeV PROTON SYNCHROTRON (NIMROD). PULSED POWER SUPPLIES AND COOLING SYSTEM USED FOR MAGNET MODELS IV AND V. A. J. Holt and J. D. Milne. May 1960. 16p. BIS.

Details are given of the application of six anode mercury-arc rectifier-inverter sets to supply unidirectional current pulses to Magnet Models IV and V. The sets deliver peak powers of up to 2 Mw at pulse repetition rates of up to 4 per minute. Associated timing units and auxiliary circuits are described. (auth)

26304 AFOSR-TN-60-935

Avco Corp. Avco-Everett Research Lab., Everett, Mass. ANALYSIS OF CONSTANT VELOCITY PULSED PLASMA ACCELERATOR. Research Report 89. Z. J. J. Stekly. July 1960. 21p. Project No. 9752. Contract AF49(638)-659.

The equations are set down in a dimensionless form for a constant-velocity pulsed-plasma accelerator, treating the accelerator as a circuit element. The equations are solved in closed form and plots of voltage, current, gas energy, and required mass distribution are obtained. It is shown that circuit inductance both reduces and delays the energy transfer from the capacitors to the gas. A typical design for a constant-velocity pulsed-plasma accelerator is obtained making use of the dimensionless plots obtained as a result of the analysis. (auth)

26305 CERN-60-29

European Organization for Nuclear Research, Geneva. OPERATION AND DEVELOPMENT QUARTERLY REPORT NO. 2 [FOR] APRIL-JUNE 1960. Aug. 12, 1960. 31p.

Sensitivity of the 50 Mev Linac was changed to 500 kv focusing conditions as a result of installation of triplets in place of solenoids. The coupling between vertical and horizontal betatron oscillations was studied for the 50 Mev beam. The radial position of the closed-orbit and Q values were measured at various energies. (For preceding period see CERN-60-23.) (C.J.G.)

26306 CERN-60-31

European Organization for Nuclear Research, Geneva. A CO-AXIAL LINE VARIABLE POWER DIVIDER AND PHASE SHIFTER FOR HIGH POWER. P. Bramham. [1960]. 43p.

In the 202 MHz r-f amplifier chain of the CERN 50 Mev linear accelerator, drive power control and isolation are provided by inserting a device in the drive to each final amplifier which will divert some of the r-f power into a load. The prototype for these units was adjusted to match the line impedance by comparing low-power measurements with calculations of the effect of various small changes in line lengths. Units for permanent use in the linac were satisfactorily made as a result of information thus gained. Calculations show that the power divider has a rather narrow bandwidth, so that the frequency of low-power measurements must be carefully controlled. (auth)

26307 MURA-584

Midwestern Universities Research Assn., Madison, Wis. ELECTROMAGNETIC SEPARATION OF SECONDARY BEAMS AT THE MURA ACCELERATOR. M. L. Good. Aug. 15, 1960. 19p. Contract AT(11-1)-384. OTS.

The problems of electromagnetic separation at Midwestern Universities Research Association machine energies are examined. It is concluded that d-c separation will handle all foreseeable needs, and poses essentially no special problems other than precision tolerances on components and, for the case of pulsed beams, a rather special target arrangement. (auth)

26308 TID-6540

Midwestern Universities Research Assn., Madison, Wis. MINUTES OF THE MURA GENERAL CONFERENCE, MADISON, WISCONSIN, MAY 16-17, 1960. 24p. OTS.

Preliminary results of orbit dynamic studies performed in connection with the design of a high-intensity spiral sector accelerator are reported. Calculations on betatron oscillations in the radial straight section in spiral sector accelerators are presented for momenta of 1, 1.5, and 2.24. Progress is reported in studies on acceleration across transition energy, r-f injection into an accelerator, the two-way accelerator, longitudinal space charge and electromagnetic instabilities of particle beams, and resonant extraction from sector focus cyclotrons. Design characteristics and construction status of the Oak Ridge Isochronous Cyclotron and the MURA Hydrogen Bubble Chamber are contained. The characteristics and preparation of semiconductor detection devices are discussed. (C.J.G.)

26309 JPRS-5403(p.178-92)

CALCULATION FOR PROTECTION OF A BETATRON WITH 25 MEV ENERGY. V. V. Dmikhovskii (Dmikhovskiy). Translated from Med. Radiol. 5, No. 5, 78-84 (1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 21024.

26310 UCRL-Trans-592(L)

CONSTRUCTION OF AN ACCELERATOR TUBE FOR IONS AT 700 KV. DEVELOPMENT OF ION SOURCES WITH OSCILLATING ELECTRONS. J. Sommeria-Klein. Translated by Wallace D. Kilpatrick from Ann. phys. 1, 344-94 (1956). 73p. JCL.

Aspects of high-voltage accelerator tubes are examined, and the development of an ion-source principle for use in conjunction with a 700-kv accelerator tube is described. Design and construction of an accelerator tube for operation at this voltage level are described, and applications for such modest voltage accelerators in industry are proposed. (J.R.D.)

26311

SATURNE: THE SACLAY PROTON SYNCHROTRON. [PART] I. R. Lévy-Mandel (Institut d'Electrotechnique, Grenoble, France). Inds. atomiques 4, No. 1-2, 71-5 (1960). (In French)

The dimensions and the construction of Saturne are described. In this first part of the article the electromagnet, which ensures the distribution of the magnetic field between 300 gauss and 15 kgauss to better than 1%, is considered. (tr-auth)

26312

ELECTRON LOSSES IN SCATTERING IN RESIDUAL GAS IN ACCELERATORS. A. G. Vlasov, A. A. Vorob'ev, A. N. Kislov, and R. P. Meshcheryakov (Kirov Tomsk Polytechnical Inst., U.S.S.R.). Izvest. Akad. Nauk. S.S.S.R. Ser. Fiz. 24, 1006-12 (1960) Aug. (In Russian)

Correlations are made of experimental and theoretical data on particle losses in scattering on residual gas. Calculation methods for estimating these losses are analyzed. (R.V.J.)

26313

ION OPTICS IN LONG, MULTISTAGE ACCELERATOR TUBES. Masateru Sonoda, Akira Katase, Masao Seki, and Yoshihisa Wakuta (Kyushu Univ., Fukuoka). J. Phys. Soc. Japan 15, 1680-4 (1960) Sept. (In English)

The recurrence formulas for the cardinal elements of a multistage accelerator tube are derived. The calculated results for an equidiameter cylinder lens obtained by the consecutive applications of the formulas are not so different from those obtained by assuming a uniform acceleration and still show the appreciable deviations from the experimental data. The errors would, therefore, become large, unless the experimental values are used for the cardinal elements of an individual accelerating lens on which the calculation for multistage accelerator tube is based. As an example, the cardinal elements for a 12-stage accelerator tube are shown. The comparison with those obtained by the assumption of a uniform acceleration shows that the latter results are not satisfactorily accurate for such a multistage accelerator. (auth)

26314

A CYCLOTRON WITH RADIALLY ALIGNED MAGNETIC WALL WAVES. E. G. Komar. Kernenergie 3, 522-6 (1960) June. (In German)

A proposed construction is given for a cyclotron with magnetic waves progressing in a radial direction, along

with the relationships between the main parameters. Using special coil windings (from an a-c generator), one or more concentric radially aligned magnetic wall waves are produced in the gap between the pole pieces of the cyclotron magnet. Two variations are suggested. In the first, the particle accelerating field is one such progressing wave; in the second, the usual cyclotron magnetic field overlaps the progressing wave so that the acceleration occurs in the total field. The spatial distribution of the fields in the waves makes a stability region possible ($1 > n > 0$) which must move with the radial particle velocity in the radial direction. A stability region is also produced when the value of the magnetic field strength in the acceleration zone from the center to the edge increases strongly. The proposed system permits, principally, construction of a cyclotron for any high energy. In spite of the cyclic operating mode of these accelerators, there is good basis for the assumption that the average intensity in it because of improved focusing can be greater than in the Phasotron. Approximate calculations are given for accelerators of the proposed type for different energies. The calculations show that the weights and diameters of such accelerators can be significantly smaller than in accelerators of other types for the same energy. (tr-auth)

26315

PULSE-SHORTENING IN ELECTRON LINEAR ACCELERATORS. M. G. Kelliher and R. Beadle (Vickers Research, Ltd., Sunninghill, Berks, Eng.). Nature 187, 1099 (1960) Sept. 24.

Experiments on a single accelerator section showed that pulse-shortening occurs in the output electron pulse first at the high-energy end of the accelerator wave guide. The current at which pulse-shortening occurs is proportional to the r-f power level in the accelerator tube. A constant-field accelerator constructed to operate at the x-band yielded currents in excess of 100 ma without showing pulse shortening as compared to 40 ma for the equivalent constant-impedance design. A field effect associated with low values of field in the normal mode or higher order spurious r-f modes may be responsible for the pulse shortening. (M.C.G.)

26316

A NEW METHOD FOR INVESTIGATION OF THE ELECTRON INJECTION IN BETATRON. A. P. Komar, G. F. Mikheev, V. P. Fominenko, and N. N. Chernov (Leningrad Inst. of Physics and Tech.). Zhur. Tekh. Fiz. 30, 855-9 (1960) July. (In Russian)

A new method is suggested for studying electron capture in betatron acceleration with electron injection into a certain arbitrarily selected orbit range. (tr-auth)

26317

THE DIVISION OF ELECTRONS IN OUTLET FROM LINEAR ACCELERATOR BY MEANS OF ELECTROMAGNETIC WAVE IN WAVEGUIDE. A. I. Zikov (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR, Khar'kov). Zhur. Tekh. Fiz. 30, 971-4 (1960) Aug. (In Russian)

A method is suggested for separating accelerated electron beams in such a way that successive electron bunches deflect in various directions at small equal angles in relation to the original beam. The method is based on electron bunch interactions with transverse electric waves of H_{10} type in a waveguide where the frequency is 2-fold lower than the bunch frequency, and the phase rate, v_t , is twice the bunch transmission rate, v_1 . Hence, the spatial wave in the waveguide is 4 times larger than the distance

between the centers of the bunches. The length of the waveguide is equal to $2\lambda_0$ (or to an odd number $(2n+1)$ times $2\lambda_0$) and the bunches enter the waveguide according to the corresponding phase (at the moment when the electric field in the waveguide equals zero). During the waveguide flight time, the electrical forces act on successive bunches and deflect them into different directions. (R.V.J.)

26318

MOTION OF STRONGLY RELATIVISTIC ELECTRON IN LINEAR ACCELERATOR UNDER THE ACTION OF ACCIDENTAL PERTURBATIONS. K. N. Stepanov (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR, Khar'kov). *Zhur. Tekh. Fiz.* **30**, 975-80 (1960) Aug. (In Russian)

A "transverse" motion of strongly relativistic electrons in a long linear accelerator, induced by errors in compensation for the earth's magnetic field and in the accelerating sections of the installation, is investigated. Owing to the great length of the accelerator the small perturbations are capable of strongly deflecting the particle from the accelerator axis. (R.V.J.)

26319

THE MODEL OF CYLINDRICAL IRON-FREE BETATRON. Yu. S. Korobochko and K. S. Shil'kov (Leningrad Polytechnic Inst.). *Zhur. Tekh. Fiz.* **30**, 981-3 (1960) Aug. (In Russian)

In ordinary betatron construction the acceleration of electrons in an axially symmetric magnetic field is described by the ratio $2:1$ and the field gradient logarithm $n = (d \log H)/(d \log r)$. The condition $0 < n < 1$ has to be fulfilled for simultaneous axial and radial focusing. The value $n = 0$ (uniform field orbit) corresponds to a complete absence of axial focusing. The stability of axial electron motion can be secured by electrical or magnetic mirrors. In heterogeneous fields the value $n = 0$ can cause resonance amplification of radial oscillations. It is shown that a sufficiently high rate of magnetic field build-up compensates the amplifications. The design and performance of iron-free betatron are described. (R.V.J.)

26320

ELECTROSTATIC GENERATOR. (to High Voltage Engineering Corp.). British Patent 848,365. Sept. 14, 1960.

An improved horizontal Van De Graaff generator in which the column is constructed in cantilever fashion out of a multiplicity of equipotential planes separated by two rows of insulators within the belt loop is designed. The equipotential planes have the effect of redistributing the bending moments in the insulators and seals between the insulators and planes, thus reducing the maximum bending moment in the column. (D.L.C.)

Plasma Physics and Thermonuclear Processes

26321 AD-241298

Munich. Technische Hochschule. Elektrophysikalisches Institut.

WAVE PROPAGATION IN A PLASMA CABLE WITH AN IMPRESSED LONGITUDINAL MAGNETIC FIELD. Technical Final Report [for] April 1, 1959 to March 31, 1960. H. Riedel and J. Thelen. 84p. Contract AF61(052)-79.

Investigations on propagation of slow waves in a plasma cable are reported. The experimental equipment consisted of a glass tube enclosed by a $1 \text{ m} \times 1.5 \text{ cm}$ cylindrical metallic tube, provided with a slot like a measuring line. There was a difference between forward waves and backward waves. The high-frequency measurements were carried

out separately for both wave types, using different methods for each type. (W.D.M.)

26322 AFOSR-TN-60-955

Avco Corp. Avco-Everett Research Lab., Everett, Mass. MAGNETOHYDRODYNAMIC PROPULSION. Research Report 90. G. Sargent Janes. Aug. 1960. 73p. Project 9752. Contract AF49(638)-659.

The morphology of plasma propulsion devices is presented following a brief discussion of the requirements for mission objectives. The two criteria employed for this classification are field-current configurations and containment. Containment is essential for efficiency and probably represents the primary area requiring further research. Both aerodynamic and magnetic containment are considered. The various categories of electrical motors are completely analogous to the categories of field-current configurations. Three specific examples of devices being studied at AERL are presented together with a qualitative discussion of the basic physical principles necessary for their understanding. (auth)

26323 LAMS-2464

Los Alamos Scientific Lab., N. Mex. QUARTERLY STATUS REPORT OF THE LASL CONTROLLED THERMONUCLEAR RESEARCH PROGRAM FOR PERIOD ENDING AUGUST 20, 1960. Samuel Glasstone, comp. and ed. Sept. 1960. 41p. Contract W-7405-eng-36. OTS.

In the entropy-trapping (picket fence) experiment, the plasma density at the input cusp was increased by moving the gun closer to the P.F. and increasing the amount of neutral gas admitted to the gun. As a result the input cusp was opened to $\beta = 1$ at 2000 gauss and a $\beta = 1$ region contained for $\sim 30 \mu\text{sec}$. The contained plasma appeared to be uncomfortably close to the chamber walls. A larger apparatus in the form of a caulked picket fence is being designed to remedy this difficulty. In the skew-trapping experiment, measurements showed complete reflection of the off-axis input beam by the far mirror. A contained beam was not observed. However, there is evidence that projecting portions of the vacuum chamber seriously intercept the beam. Potential probes in a hydromagnetic gun were used to measure the induced radial voltage as the sheath sweeps B_0 past the probe. The plasma velocity deduced from this voltage and the magnitude of B_0 was in excellent agreement with direct measurements. Differential probe measurements showed that the radial voltage drop along the sheath occurs mostly within 3 mm of the center electrode, indicating a cathode drop similar to that of classical glow discharges. The large toroidal discharge, Perhapsatron S-5 Zeus, was put into successful operation. Measurements showed that the pinch current agrees approximately with that predicted on the basis of previous experience. Neutron bursts of about 10^8 were obtained, but tests at voltages higher than 17.5 kv were terminated by failure of the quartz torus. The microwave-scattering experiment was improved by the application of a microwave phase-shift interferometer in order to measure the electron density. The measurements showed that the density attained was too low to produce a detectable scattered signal in the receiver. Steps are being taken, therefore, to improve the r-f ionization system. Parts are being ordered to enable a search for radiation scattered by collective ion oscillations. A technique was developed for measuring the electron temperature as a function of time on a single discharge in Scylla. It was found that the temperature during a given half-cycle of compression field peaks later than B_z , as would be expected from a simple model of adiabatic compression and collisional energy exchange between electrons and ions.

With preionized operation, soft x rays were not produced on the first half-cycle for $+B_0$, but appeared for zero and negative bias fields. There is thus a striking independence of the soft x-ray and neutron signals, since the latter do not appear for $B_0 = 0$. This independence also occurs in crowbarred operation in which the neutron pulse is extended while the x-ray signal is not. A vacuum x-ray spectrometer using beryl diffraction crystals is being put into operation. It will be used for the direct measurement of the Scylla soft x-ray spectrum. The assumption that the Scylla ion and electron temperatures can be accounted for by adiabatic compression was tested by means of a simple mathematical model. It was assumed that the only two processes operating were adiabatic compression and collisional interchange of energy between the ions and electrons. This model can account for the ion and electron temperatures (1.3 kev and 240 ev, respectively) at peak compression only if the electron-ion relaxation time is greater than three times the Spitzer value. In the orthogonal-pinch experiment, magnetic studies of a deuterium discharge were continued with emphasis on external field and flux measurements. Preliminary calculations of plasma radius vs. time are being made using the experimental data. Scaling of the physical dimensions and a reduction in the mirror ratio leads to larger neutron yields extending in time throughout a B_z zero. The possible causes of the events leading to the onset of field intermixing are considered to be of basic importance. Electrostatic probes were applied in the Ixion experiment to determine the radial potential distribution. The results showed a region of very low electric field near the outer wall and confirmed the existence of an equipotential region at the center of the device whose radius is determined by the magnetic field and the size of the end electrodes. Ultrahigh vacuum techniques similar to those applied in other Sherwood laboratories are being developed. Experience is being gained in the use of baked-metal systems with oil-diffusion pumps. With this equipment, vacua in the range of a few times 10^{-10} mm Hg are being attained. A stable plasma-confinement configuration called Helixion, is proposed which reduces the cusp losses of picket-fence geometries; it is adaptable to both toroidal and linear systems. Basically, it consists of a magnetic field produced by an external tight helical winding together with an open internal helix. Since the current to the latter would have to be supplied by induction in a toroidal system, the operation would be discontinuous. This drawback can be overcome by using a linear geometry and opening up the coils of the internal helix at the ends of the tube to provide connections to an outside source. Losses would occur at the ends, but their effect could be minimized by the use of a long tube. (For preceding period see LAMS-2444.) (auth)

26324 MATT-14

Princeton Univ., N. J. Project Matterhorn. ELECTRON GUN MEASUREMENTS IN A STELLARATOR WITH HELICAL STABILIZING WINDINGS. M. S. Jones, Jr., G. Hess, and L. G. Smith. July 21, 1959. 26p. Contract AT(30-1)-1238. OTS.

The rotational transform of the magnetic confining field of the ETUDE Stellarator, which is caused by a series of transverse multipolar helical fields, was measured for a variety of conditions. The results are compared with various theoretical predictions. Magnetic surfaces were also measured and analyzed to determine the effectiveness of quarter-wave circularizing sections. (auth)

26325 MATT-44

Princeton Univ., N. J. Project Matterhorn. THE EFFECT OF ROTATION ON THE STABILIZED

PINCH. Agnar Pytte. June 1960. 10p. Contract AT(30-1)-1238. OTS.

It is shown that the marginally stable pinch becomes hydromagnetically unstable when given a small rotation. (auth)

26326 MATT-Q-10

Princeton Univ., N. J. Project Matterhorn. QUARTERLY REPORT COVERING THE PERIOD JANUARY 1-MARCH 31, 1960. Sept. 1960. 35p. Contract AT(30-1)-1238. OTS.

Continuing studies on confinement in B-3 yielded the following two results: (1) During ohmic heating pumpout starts at the beginning of the discharge. The rate of particle loss during the initial phase of the discharge, when the hydrogen is being ionized, is about the same as later when the ionization is complete. (2) Confinement measures on partially ionized gases, following a short interval of ionization by the breakdown oscillator, show that at pressures exceeding several microns the electron decay is independent of magnetic field, and is consistent with recombination only. At low pressures the RF breakdown oscillator produces runaway electrons, with energies exceeding 10 kv, and rapid pumpout is observed following the RF discharge. Evidently pumpout occurs throughout the ohmic heating discharge but is absent, or at least unimportant, in the high-pressure, partially ionized plasma produced by RF breakdown. It is not yet clear, however, which are the important causative agents in producing the pumpout phenomenon. Theoretical analysis of the kink instability, for a plasma of negligible pressure, was carried out for a toroidal system. Curvature seemed to have no effect on the criterion for instability, at least in lowest order. Stabilization of the kink instability in a stellarator, by means of the helical windings, would thus appear firmly established theoretically for sufficiently low pressures. Installation of most of the equipment for the C stellarator has proceeded rapidly. However, delays on coil fabrication pushed back the anticipated first-stage operation of this device by several months; operation is now scheduled for early 1961. (For preceding period see MATT-Q-9.) (auth)

26327 NASA-TN-D-380

National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va. TEMPERATURE AND COMPOSITION OF A PLASMA OBTAINED BY SEEDING A CYANOGEN-OXYGEN FLAME WITH CESIUM. Richard A. Hord and J. Byron Pennington. May 1960. 19p. OTS.

The temperature and composition of a $C_2N_2-O_2$ flame seeded with cesium are calculated approximately by assuming that the combustion is adiabatic and that the product mixture is in thermodynamic equilibrium. For initial mole fractions of cesium up to 0.1 and flame pressures from 0.01 to 1 atmosphere, electron concentrations up to 4.4×10^{16} per cc and plasma temperatures of 4,000 to 5,000°K are obtained. (auth)

26328 NP-9022

General Electric Co. Flight Propulsion Lab. Dept., Evendale, Ohio.

XM-731 PLASMA ENGINE RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report No. 1. June 1960. Boyd W. Harned and M. L. Ghai. 48p. Contract AF33(616)-7176. Includes Appendixes: I. TYPICAL CURVES FROM THE ELECTRICAL CONDUCTIVITY OF SEEDED INERT GASES. A. Sherman. Mar. 1960. (R60FPD237). II. INDUCED MAGNETIC FIELDS IN MHD CHANNEL FLOWS. A. Sherman. Apr. 1960. (R60FPD301).

The specific program under investigation involves an ex-

perimental and analytical determination of conditions for efficient acceleration of plasma in a crossed-field device. Experimental work was initiated with the design and construction of an electrothermal jet plasma generator with cesium feed-control mechanism. Testing of two accelerator models was carried out and some items of instrumentation were investigated. The analytical program provided much useful information, including insight into the problem of adverse current flow in the accelerator channel. Reports of evaluation of electrical conductivity for pertinent mixtures and induced magnetic fields through plasma current flows are included. (W.D.M.)

26329 NP-9191

Space Technology Labs., Inc. Physical Research Lab., Los Angeles.

EXCITATION OF ALFVEN WAVES. Roy W. Gould.

May 24, 1960. 27p. Contract AF04(647)-309. (STL/TR-60-0000-09143).

The nature of waves that can propagate in a cold plasma that is immersed in a strong magnetic field and surrounded by a perfectly conducting cylinder is examined. The excitation of these waves is determined for the geometry used by Wilcox and by Jones. (W.D.M.)

26330 NP-9218

Space Technology Labs., Inc. Physical Research Lab., Los Angeles.

LONGITUDINAL ION OSCILLATIONS IN A HOT PLASMA.

Burton D. Fried and Roy W. Gould. June 28, 1960. 38p. (STL/TR-60-0000-GR185).

The linearized, longitudinal waves in a hot plasma include, besides the familiar electron plasma oscillations, in which the frequency ω is of order $\omega_p = (4\pi ne^2/m)^{1/2}$, also ion plasma oscillations with $\omega \approx \omega_p(m/M)^{1/2}$. The properties of these ion plasma oscillations are explored using a Vlasov equation description of the plasma. For equal ion and electron temperatures, $T_e = T_i$, there exists a discrete sequence of ion plasma oscillations, but all are strongly damped. The ratio $\text{Im}\omega/\text{Re}\omega$ can be made to approach zero (facilitating detection of the waves) by either increasing T_e/T_i or by producing a current flow in the plasma. In the latter case, $\text{Im}\omega$ can even be made positive (corresponding to growing waves), the current required for this being smaller the larger the value of T_e/T_i . This growing wave is just the familiar two-stream instability which is thus seen to be an unstable ion plasma oscillation. It is also noteworthy that the ion plasma oscillations, which for small k have the properties usually associated with an acoustic wave, are obtained using a formalism which is sometimes designated as "collisionless". (auth)

26331 NYO-2883

New York Univ., New York. Inst. of Mathematical Sciences. ON PLASMA-MAGNETIC SHOCKS. Marian H. Rose. Mar. 15, 1960. 40p. Contract AT(30-1)-1480. (MF-4) OTS.

The possible existence of a shock in a high-temperature collisionless plasma situated in a magnetic field is considered. The underlying equations are those of conservation of mass, momentum, and energy for each component coupled with Maxwell's equations. The stress tensor is assumed to be anisotropic, its exact form being derived from guiding-center theory. The conclusion is that no shock solution is contained in this system of equations. (auth)

26332 NYO-9353

New York Univ., New York. Inst. of Mathematical Sciences.

EQUILIBRIUM CONFIGURATION OF A PLASMA IN THE

GUIDING CENTER LIMIT. Alan Oppenheim. Sept. 15, 1960. 29p. Contract AT(30-1)-1480. (MF-5). OTS.

The equilibrium configuration of a collision-free plasma contained in an axially symmetric magnetic field is computed. The plasma is characterized by a non-scalar pressure tensor which is obtained from a microscopic distribution function in a form suggested by the guiding center approximation. The solution is calculated in the limit where the ratio of the width to the length of the plasma region and the ratio of the gas to the magnetic pressure are both small. Boundary values at the mid-plane as well as the shape of the plasma appear as arbitrary parameters in the solution. The solution to a corresponding scalar pressure problem is given for comparison. (auth)

26333 RADC-TN-60-54

Sylvania Electric Products Inc. Microwave Physics Lab., Mountain View, Calif.

ENERGY TRANSFER IN PLASMAS. Technical Note No. 4. Feb. 19, 1960. 49p. Contract AF30(602)-2050. (AD-234922).

A mathematical analysis of electromagnetic propagation in an inhomogeneous plasma is given. WKB methods are extended by the use of certain classes of Hankel functions and hypergeometric functions. Density profiles are found for which solutions can be given in exact form. The effects of plasma nonlinearities on the propagation of electromagnetic waves are discussed. Calculation of the generated second-harmonic frequency shows that there is no indefinite build-up with distance. Moreover, except in the neighborhood of cyclotron resonance, power losses to the harmonic are entirely negligible. An experiment designed to produce a controlled nonuniform plasma is briefly described. A suggestion to use acoustic waves as a diagnostic tool to measure energy transfer between electrons and the gas is discussed. (auth)

26334 UCRL-5392

California. Univ., Livermore. Lawrence Radiation Lab. SMALL-SCALE INSTABILITIES OF THE PINCH AND A SUGGESTED REMEDY—THE LEVITRON. S. A. Colgate and H. P. Furth. Nov. 1958. Changed from OFFICIAL USE ONLY July 20, 1960. 27p. Contract W-7405-eng-48. OTS.

Experimental results on the classical stabilized pinch are reviewed. The main obstacle to further progress is shown to be small-scale turbulence of the plasma. This turbulence may either be hydromagnetic or induced by run-away electron streams. Whether or not hydromagnetic effects are important can be determined by means of a configuration having a high degree of hydromagnetic stability, the inverse stabilized pinch. In this configuration there is a rigid center conductor or "hard core," then, going radially outward, a region of B_θ , a cylindrical surface current concentric with the hard core, a region of B_z , and finally a conducting outer shell. More general configurations are also of interest, and their stability against both bulk and surface perturbations is considered. Toroidal hard core pinches can be made in the Levitron, a toroidal pinch tube inside which a rigid toroidal conductor is levitated by means of an induced magnetic field. The usefulness of the Levitron in a Stellarator type operation is discussed. Some practical details of the levitation process are given. An alternative scheme is considered where the toroidal core is suspended from current-carrying wires, but this approach does not appear promising. In a reactor of the Levitron type, special problems arise, such as the cooling of the hard core, but no basic new obstacles are expected. (auth)

26335 UCRL-5418-T

California. Univ., [Livermore. Lawrence] Radiation Lab. RADIAL DISTRIBUTION OF PLASMA IN ASTRON'S E-LAYER. Lewi Tonks. Dec. 1, 1958. 3p. OTS.

The analysis of the relation between plasma pressure in the Astron and the magnetic field of the E-layer is made more general, with no restriction as to the exponential form and satisfying the condition that the pressure at the axis shall be zero. (W.D.M.)

26336 UCRL-5998

California. Univ., Livermore. Lawrence Radiation Lab. PROBE MEASUREMENTS ON THE P-4 SYSTEM IN SINGLE CATHODE OPERATION (thesis). Duane M. Gall. May 1960. 27p. Contract W-7405-eng-48. OTS.

Submitted to the United States Naval Postgraduate School, Monterey, Calif.

The plasma of the P-4 system in single-cathode operation is examined by probe techniques and compared with data taken previously in two-cathode operation. Although no radical differences were discovered, the data confirm the visual observation that the plasma column is more sharply defined in single-cathode operation. (auth)

26337 UCRL-6011

California. Univ., Livermore. Lawrence Radiation Lab. ELECTRON BEAM PINCH (thesis). Edward R. Horton and Ross L. Spoerlein. June 1960. 27p. Contract W-7405-eng-48. OTS.

One of the major objects of current plasma-pinch research is an understanding of turbulence and its effects in enhanced diffusion rates within a pinch. As an approach to this problem, the electron-beam pinch was conceived. An experiment in which an electron beam (400 kev, 0.1 amp, 0.1- μ sec duration) enters a linear pinch at one electrode and is observed (by light from a phosphor screen) at the opposite pinch electrode is described. By a selection of radial positions and time of injection, the turbulent-pinch configuration may be explored. Use of a probe with such small mass (a beam of electrons) may yield important information on turbulent diffusion. Results of preliminary tests and the first effort to obtain parameter dependence of the pinch configuration are presented. (auth)

26338 UCRL-9110

California. Univ., Berkeley. Lawrence Radiation Lab. INSTABILITY OF A POSITIVE COLUMN IN A MAGNETIC FIELD. T. K. Allen, George A. Paulikas, and Robert V. Pyle. May 27, 1960. 22p. Contract W-7405-eng-48. OTS.

The losses from the positive column of a glow discharge in an axial magnetic field are enhanced at a critical magnetic field, B_c , by the transition from an azimuthally symmetric discharge to a constricted, rotating helical discharge. No explanation for this instability is given; empirically, B_c is approximately proportional to the square roots of the ion mass and approximately inversely proportional to the radius of the discharge tube and is almost independent of the discharge current over the range of 0.05 to 5 amp. (auth)

26339 CEA-tr-A-412

RÉACTIONS THERMONUCLÉAIRES DANS LES PLASMAS DE DECHARGES AU SEIN DE GAZ. (Thermonuclear Reactions in Plasmas from Discharges in Gases). W. Rieder. Translated into French from *Elektrotech. u. Maschinenbau* 74, 261-7(1957). 29p.

A survey is presented of the possibilities for producing energy using thermonuclear reactions, based on a literature review. (43 references). (T.R.H.)

26340 UCRL-Trans-589(L)

A NEW METHOD OF PLASMA GENERATION FOR ION SOURCES. A. Ziegler. Translated by W[allace] D. Kilpatrick from *Z. angew. Phys.* 10, 185-6(1958). 6p. JCL.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 12, as abstract No. 9920.

26341

THE FRONT OF AN ELECTROMAGNETIC WAVE IN AN IONIZED GAS SUBJECTED TO A MAGNETIC FIELD. Marialuia de Socio. *Atti accad. nazl. Lincei. Rend., Classe sci. fis., mat e nat.* 27, 368-73(1959) Dec. (In Italian)

Previously, the propagation in any direction of a non-sinusoidal electromagnetic wave in an ionized gas subjected to a constant magnetic field was studied. In particular the properties of the field in the proximity of the wave front were investigated. In the present work, it is shown that the field and its first partial derivative do not vary at the wave front during propagation. (J.S.R.)

26342

THE PROPAGATION OF WAVES IN A PARTIALLY IONIZED MEDIUM. Annie Baylin. *Compt. rend.* 251, 684-5(1960) Aug. 1. (In French)

The equation for the propagation of plane waves was written in the case where the magnetic field is longitudinal. The longitudinal and perpendicular modes are then separated. They are studied successively for the low frequencies. Their propagation velocity and damping coefficient are determined. (tr-auth)

26343

SETTING IN MOTION AND DAMPING OF A CYLINDRICAL VOLUME OF CONDUCTOR LIQUID IN ROTATION IN A MAGNETIC FIELD. René Causse and Yves Poirier (Faculté des Sciences, Algiers). *Compt. rend.* 251, 1056-8(1960) Aug. 29. (In French)

A theoretical study is made of the setting in motion and the damping of a cylindrical volume occupied by a conducting liquid and submitted to a magnetic field perpendicular to the axis of rotation. The basic parameters of the fluid are derived, and the theoretical curves for some values of these parameters are given. (tr-auth)

26344

LEAKS IN PERMANENT NORMAL OPERATION OF A TWO-TEMPERATURE PLASMA CONFINED BY A MAGNETOSTATIC FIELD. Jean-Michel Dolique. *Compt. rend.* 251, 1163-5(1960) Sept. 12. (In French)

Previously, the leaks caused by the diffusion of particles perpendicularly to the lines of magnetic force in a plasma column confined by a magnetostatic field were calculated (for a permanent operation). The electron and ion temperatures were assumed equal: $T_e = T_i = T$. The results obtained are generalized to the case $T_e \neq T_i$, the case most frequently found experimentally. (tr-auth)

26345

THE STABILITY OF PLASMA IN THE FIELD OF A MAGNETIC DIPOLE. B. B. Kadomtsev and V. E. Rokotyan. *Doklady Akad. Nauk S.S.S.R.* 133, 68-70(1960) July 1. (In Russian)

A theoretical analysis was made of plasma instability in a dipole field. The analysis carried out in hydrodynamic approximation for isotropic particle distribution by velocities produces a more accurate stability criterion than precise kinetic analysis. (R.V.J.)

26346

MEASURING METHODS FOR TOTAL CROSS SECTIONS IN PARTICLE INTERACTIONS IN DENSE PLASMA. L. V. Dubovoi and O. M. Shvets. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. **24**, 1013-17(1960) Aug. (In Russian)

The total cross sections for electron or ion interactions in plasma are measured by a method which exploits the properties of plasma in a magnetic field. The method is based on the relation of plasma conductivity in cyclotron resonance to the particle-interaction cross section. The presence of a magnetic field permits the separation of the total plasma conductivity into components related to the type of particle in which the resonance condition is fulfilled. The suggested method can be applied in measuring interactions in plasmas with 10^6 to 10^{14} particles per cm^{-3} . (R.V.J.)

26347

SCATTERING OF ELECTROMAGNETIC WAVES FROM AN INFINITELY LONG MAGNETIZED CYLINDRICAL PLASMA. P. M. Platzman and H. T. Ozaki (Hughes Research Labs., Malibu, Calif.). J. Appl. Phys. **31**, 1597-1601(1960) Sept.

The magnetically contained plasma is characterized, in an average way, in terms of its macroscopic dielectric tensor. The problem of the scattering of plane electromagnetic waves from a uniform cylindrically symmetric plasma configuration was solved analytically. Numerical results for the uniform case were obtained and graphed for interesting ranges of the parameters involved. Possible applications of the results for use in investigating the plasma's properties are discussed. (auth)

26348

SCATTERING OF RADIATION BY A PLASMA. Forrest I. Boley (Wesleyan Univ., Middletown, Conn.). J. Appl. Phys. **31**, 1692(1960) Sept.

By the use of a discharge tube, the ratios of positive column currents for the primary and secondary resonances were determined as a function of applied frequency. According to Hershberger's argument, the ratios would be independent of frequency, however, the ratios were found to be frequency dependent. (M.C.G.)

26349

SOLUTION OF THE COLLISIONLESS BOLTZMANN EQUATION USING A DIAGRAM TECHNIQUE. Oldwig von Roos (California Inst. of Tech., Pasadena). J. Math. Phys. **1**, 112-20(1960) Mar.-Apr.

The diagram technique recently developed for the solution of Liouville's equation was extended and suitably modified to cover the case of the collisionless Boltzmann equation for a plasma. The usefulness of the method is demonstrated by two problems. These are: first, the influence of a plane polarized electric wave on the electron distribution function of a low-temperature plasma, and second, the propagation of a (small) initial disturbance for the case of a plasma which is governed by the Vlasov equation. (auth)

26350

LONGITUDINAL PLASMA OSCILLATIONS. J. D. Jackson (Space Technology Labs., Inc., Los Angeles). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research **1**, 171-89(1960) July.

An account is given of various aspects of longitudinal oscillations in one- and two-component plasmas. A discussion is offered of dispersion equations, conditions necessary for the growth or decay of oscillations, the physical mechanisms of growing or damping, and the possibility of

arbitrary steady-state solutions. The physical situation is described in terms of Poisson's equation and the Boltzmann equation, while the mathematical description is in terms of solutions of an initial-value problem in the small amplitude (linearized) approximation. Some general results are derived for an arbitrary unperturbed velocity distribution of electrons and ions. From these expressions the customary results for a stationary plasma in thermal equilibrium can readily be obtained. For simplicity, one dimensional motion of a simple one-component plasma is treated in detail; appropriate generalizations for two or more component plasmas (electrons and ions) are, however, indicated in text. Collisions between particles and non-linear effects are not considered, nor are the effects of external electric or magnetic fields. (auth)

26351

NEUTRON EMISSION FROM LINEAR PINCHES IN DEUTERIUM AT HIGH RATES OF CURRENT RISE. H. A. B. Bodin, R. A. Fitch, and N. J. Peacock (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research **1**, 206-14(1960) July.

The neutron emission observed during an investigation of the characteristics of fast linear Z-pinches using a low-inductance condenser bank is described. The neutron production is compared with the results obtained elsewhere and is shown to be different in several respects from that obtained with low-power banks, but is quite similar to that reported in more recent, high-power experiments. It is shown that much of the yield is non-thermonuclear, and a number of existing theories for the production of neutrons by acceleration processes in a plasma are discussed. A process of neutron production in fast linear pinches is suggested, which qualitatively accounts for many recently reported results. The proposed mechanism becomes the well-known Colgate process in discharges where $m = 0$ instabilities lead to narrow necks in the plasma. Reasons are given to account for the absence of appreciable thermonuclear yields which might be expected from theoretical considerations. (auth)

26352

INSTABILITY OF THE POSITIVE COLUMN IN A MAGNETIC FIELD AND THE "ANOMALOUS" DIFFUSION EFFECT. B. B. Kadomtsev and A. V. Nedospasov (Inst. of Atomic Energy, Academy of Sciences, Moscow). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research **1**, 230-5(1960) July.

The positive column of a gas discharge was shown to become unstable when a sufficiently large longitudinal magnetic field was superimposed. This instability caused oscillations which led to an increase in the flux of charged particles striking the walls; that is, in agreement with the experimental results, there was an increase in the effective diffusion. (auth)

26353

THE INJECTION OF PLASMOIDS INTO A MAGNETIC TRAP WITH A FIELD WHICH INCREASES TOWARDS THE PERIPHERY. I. M. Podgorny and V. N. Sumarokov (Inst. of Atomic Energy, Academy of Sciences, Moscow). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research **1**, 236-9(1960) July.

The feasibility of filling up a magnetic trap with plasma was investigated by injecting accelerated plasmoids into a trap formed by a magnetic field which increased toward the periphery. It is shown that in such a system the lifetime of the plasma is several tens of microseconds under the conditions of these experiments. (auth)

26354

THE CONFINEMENT OF SHOCK-HEATED PLASMAS IN MIRROR MAGNETIC FIELDS. J. K. Wright and N. J. Phillips (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research **1**, 240-3(1960) July.

In the device for the confinement of shock-heated plasma, the magnetic field may be largely external to the plasma, in contrast to the mirror machines in which the plasma is well mixed with its confining magnetic field. The case in which the central plasma density and temperature are such that the ion scattering time is so small that the ion pressure is isotropic is considered and methods of confinement discussed. The condition which apparently exists in the Scylla, that of a plasma surrounded by a thin skin of field and plasma, is also discussed. (M.C.G.)

26355

END LOSS IN THE LINEAR θ -PINCH. K. V. Roberts (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Energy, Pt. C. Plasma Phys.-Accelerators-Thermonuclear Research **1**, 243-4(1960) July.

Configurations in θ -pinch in which some of the magnetic field lines that pass through the mirrors are mixed throughout the plasma are considered. This could happen by breakdown on the first half-cycle of the current without preionization or if breakdown did not occur until the second half-cycle, some reversed flux from the first half-cycle could be trapped within the gas. The loss of plasma from such configurations was studied. (M.C.G.)

26356

TRANSPORT COEFFICIENTS OF PLASMAS IN A MAGNETIC FIELD. Shobu Kaneko (Tokyo Univ.). J. Phys. Soc. Japan **15**, 1685-96(1960) Sept. (In English)

The electric and thermal conductivities and the coefficient of the thermal diffusion of plasmas in a magnetic field were calculated under the assumption that the mass ratio, m_2/m_1 , is considerably smaller than unity, where m_1 and m_2 are masses of an ion and an electron, respectively. Thereby the terms of the order $(m_2/m_1)^{1/2}$ are retained, considering the application to the deuterium plasma; the higher-order terms are neglected. For various strengths of the magnetic field, these coefficients are evaluated by the Chapman-Enskog method up to the 6th approximation, and the convergence of this method is examined. The probable error of our approximation varies from 0.1 to 10% with the strength of the magnetic field. (auth)

26357

PROPAGATION OF MICROWAVES THROUGH A MAGNETO-PLASMA, AND A POSSIBLE METHOD FOR DETERMINING THE ELECTRON VELOCITY DISTRIBUTIONS. A. L. Cullen (Stanford Univ., Calif.). J. Research Natl. Bur. Standards **64D**, 509-13(1960) Sept.-Oct.

Sagdeyev and Shafranov have shown that the absorption of microwaves in a hot plasma in a steady magnetic field can be calculated in simple closed form with the help of the Boltzmann equation, provided that the effect of collision can be ignored. The special case of propagation of circularly polarized waves parallel to the magnetic field, and the extraordinary ray, in magneto-ionic terminology, were studied. It is shown that the formula given by Sagdeyev and Shafranov for this case can be deduced by considering the motions of individual electrons by elementary dynamical

methods, using the concepts of Doppler shift and velocity distribution functions to obtain a macroscopic conductivity formula for a high-temperature plasma. From this, the absorption is calculated. It is emphasized that the calculation in no way depends upon the assumption of a Maxwellian velocity distribution function. The absorption can in fact be obtained in closed form for any arbitrary velocity distribution function. This suggests that a diagnostic technique for the determination of velocity distribution could be based on measurements of absorption of the extraordinary ray, and the potentialities and limitations of this proposal are briefly discussed. (auth)

26358

STATISTICAL MECHANICS OF RELATIVISTIC STREAMS. [PART] I. K. M. Watson (Univ. of California, Berkeley), S. A. Bludman, and M. N. Rosenbluth. Phys. Fluids **3**, 741-7(1960) Sept.-Oct.

The small-amplitude motion of a relativistic beam passing through plasma was studied using transport theory. For the equilibrium state, a relativistic Maxwellian velocity distribution was obtained. The linearized Boltzmann equation was used to relate beam and plasma density and current perturbations to perturbations in the electromagnetic field. Approximate criteria were obtained to justify the neglect of static fields. Finally, these general results were specialized to those of a uniform beam. (auth)

26359

STATISTICAL MECHANICS OF RELATIVISTIC STREAMS. [PART] II. S. A. Bludman (Univ. of California, Berkeley), K. M. Watson, and M. N. Rosenbluth. Phys. Fluids **3**, 747-57(1960) Sept.-Oct.

The stability of a uniform relativistic beam of particles injected into a plasma was studied using the previously developed linear-transport theory. Velocity distribution in the beam and electron-ion collisions in the plasma were considered. For wave propagation in the beam direction, an exact treatment is given, while for oblique angles between plasma waves and the beam two kinds of perturbation theory were developed. The two electromagnetic modes of beam-plasma oscillation were found to be always stable, but growing electrostatic oscillations were possible for long enough wavelengths. For short wavelengths or high temperatures this mode was also stable. Boundary effects and the effects of static fields were not considered. (auth)

26360

DIFFUSION THROUGH A FINITE PLASMA IN A UNIFORM MAGNETIC FIELD. Lewi Tonks (General Electric Co., Pleasanton, Calif.). Phys. Fluids **3**, 758-64(1960) Sept.-Oct.

The anisotropic diffusion of ions and electrons in a non-multiplying partially ionized plasma lying in a strong uniform magnetic field was analyzed to zero and first order in the parameter Ω^{-1} , where Ω^2 is the ratio of the reduction of transverse electron mobility to the reduction of transverse ion mobility due to the magnetic field. This obviated the need for an earlier erroneous assumption. Potential distribution and electron and ion current flows were formulated for two-dimensional flow, using a lowest-harmonic charged-particle distribution in a rectangular space and various wall-current conditions. The encroachment of sheaths inward from the walls was not considered on the basis that, in principle, the charged-particle concentration could always be assumed to be large enough to keep this complication small. (auth)

26361

PLASMA INJECTION INTO A MAGNETIC FIELD OF

CUSPED GEOMETRY. F. H. Coensgen, A. E. Sherman, W. E. Nexsen, and W. F. Cummins (Univ. of California, Livermore). *Phys. Fluids* **3**, 764-8(1960) Sept.-Oct.

A plasma stream was directed from a field-free region along the axis of symmetry into a magnetic field of biconical cusped geometry. No evidence was found to support the hypothesis that a directed plasma stream can not penetrate a magnetic field whose value exceeds $B_c^2 = 12\pi\rho v^2$, where ρ is the plasma density and v its directed velocity. As the plasma penetrated the magnetic field, the plasma and field were found to intermix. Large quantities of the plasma which entered the containment region through one point cusp were found to leave promptly through the second point cusp and through the line cusp. Bombardment of the vacuum-chamber walls in the vicinity of the line cusp generated sufficient secondary ions to mask any small-scale plasma trapping. However, there was no evidence of gross trapping of the injected plasma. (auth)

26362

SHOCK WAVE AND SOLITARY WAVE STRUCTURE IN A PLASMA. O. W. Greenberg (Air Force Cambridge Research Center, Bedford, Mass.) and Y. M. Trève. *Phys. Fluids* **3**, 769-85(1960) Sept.-Oct.

Plane steady shock waves and solitary waves in a hydrogen plasma without external magnetic fields were studied using a simple kinetic-theory model to describe the plasma. This model uses a Mott-Smith distribution for the protons and a local Maxwellian distribution for the electrons. Charge separations occurred inside the shock front because of the proton-electron mass difference. The proton and electron densities and the electric field had an oscillatory fine structure with characteristic length $\sim 10 \lambda_D$, where M is the Mach number and λ_D the Debye length, going through the shock. In these oscillations, the densities overshoot their final Rankine-Hugoniot condition values. The distance in which the oscillations decayed to $1/e$, which can be taken as the shock width, was $\sim 4\lambda$, where λ is the mean free path in the unshocked gas, in the range of Mach numbers considered. There were no continuous solutions for this model above Mach 2.19. The peak electric fields inside the shock were large. In a plasma of $\lambda/\lambda_D = 2 \times 10^4$, the electric field reached 2.2×10^6 v/cm in a Mach 2.1 shock. The large-amplitude solitary waves, which were the basic ingredient of the fine structure of the shock, were studied separately, and a heuristic picture is presented of the growth of these solitary waves, which was due to the coupling between the bulk flow of the plasma and the internal electric fields generated by charge separation. The rate of decay of these solitary waves was estimated. (auth)

26363

DRIFT INSTABILITIES IN A MAXWELLIAN PLASMA. E. Atlee Jackson (Princeton Univ., N. J.). *Phys. Fluids* **3**, 786-92(1960) Sept.-Oct.

The stability of two Maxwellian components of a plasma, which had different drift velocities, was investigated by means of a graphical solution of the dispersion relation. The graphical technique has the advantage of exhibiting the content of the dispersion relation in a transparent manner. By this method the region of instability was determined as a function of the perturbation wavelength λ and the relative velocity of the components. It was shown how this region depended on the ratio of the Debye lengths and plasma frequencies. In the case of an electron-proton plasma the maximum growth rate was obtained as a function of λ and the critical drift velocity as a function of the temperature ratios. The structure of the unstable region was also indicated by a few lines of constant growth rate. (auth)

26364

ELECTRIC FIELD CORRELATION AND PLASMA DYNAMICS. J. B. Taylor (Univ. of California, Berkeley). *Phys. Fluids* **3**, 792-6(1960) Sept.-Oct.

The correlation function for the electric field in a fully ionized plasma was derived, and its application to the problem of finding the force on a charge moving slowly through a plasma was described. The correlation function was evaluated for a plasma with and without a magnetic field, and this function was then converted to the spectrum of the mean-square fluctuation in the random electric field. The application of the generalized fluctuation-dissipation theorem gave the mean force on a slowly moving test charge. The relation of this to other treatments is briefly discussed. (auth)

26365

POSSIBILITY OF AN ELECTROSTATIC INSTABILITY IN A STELLARATOR. R. A. Ellis, Jr., L. P. Goldberg, and J. G. Gorman (Princeton Univ., N. J.). *Phys. Fluids* **3**, 797-9(1960) Sept.-Oct.

At certain times during Ohmic heating in hydrogen and deuterium discharges in the B-3 stellarator, it was observed that over a wide range of experimental conditions the plasma current decreased abruptly (current inhibition) following a period of increasing current and decreasing charged particle density. It is suggested that this may be a manifestation of an electrostatic instability. (auth)

26366

RADIATION OF HYDROMAGNETIC WAVES. Robert Karplus (Univ. of California, Berkeley). *Phys. Fluids* **3**, 800-5(1960) Sept.-Oct.

The dyadic Green's function for hydromagnetic waves in a uniform, fully ionized, perfectly conducting, pressureless fluid was obtained. The electromagnetic field consisted of two modes, one that propagated isotropically and one that propagated along the field lines. The radiation rate from some simple model current distributions was derived from the Green's functions. If the source contained a current along the constant static field, then the radiation along the field lines through the source was very intense. This last result also held in the nonuniform static field of an infinitely long straight wire. (auth)

26367

INTERACTION BETWEEN COLD PLASMAS AND GUIDED ELECTROMAGNETIC WAVES. S. J. Buchsbaum (Bell Telephone Labs., Inc., Murray Hill, N. J.), Lyman Mower, and Sanborn C. Brown. *Phys. Fluids* **3**, 806-19(1960) Sept.-Oct.

The microwave-cavity method for the measurement of various parameters of a cold plasma in the presence of a static magnetic field was examined. Emphasis was placed on the determination of the limits of validity of the perturbation theory for various mode configurations of a cylindrical cavity coaxial with a plasma column and coaxial with the static magnetic field. The classes of modes examined were those which in the absence of the magnetic field reduced to the TM_{0m0} , TM_{1mn} , TE_{1mn} , and TE_{0mn} modes. For the TM_{0m0} and TE_{0mn} modes, exact expressions for the cavity-frequency shifts were obtained. These expressions were then expanded in appropriate power series to obtain the limits of validity of the perturbation method. For the TE_{0mn} modes the perturbation theory had to be modified to account for the polarization of the plasma. In the absence of a magnetic field, the TM_{1mn} as well as the TE_{1mn} modes were degenerate in their resonant frequencies. The presence of a magnetic field removed the degeneracy and

caused the resonant frequency to be double-valued. An experimental test of the validity of the perturbation method can be had by comparing the two resonant frequencies. The relation is given between the characteristics of the various modes and the propagation of plane waves in infinite uniform plasmas. (auth)

26368

NONLINEAR OSCILLATIONS IN A COLD PLASMA.

E. Atlee Jackson (Princeton Univ., N. J.). *Phys. Fluids* **3**, 831-3(1960) Sept.-Oct.

The one-dimensional density perturbations of a plasma were found to oscillate at the plasma frequency. The behavior of the Eulerian variables was derived from known Lagrangian results. Once this behavior was established, the time dependence of the Fourier modes of density was obtained. Finally a perturbation scheme was developed that could be applied directly to the Eulerian equations in order to avoid the complexity of Fourier mode analysis. (M.C.G.)

26369

BEHAVIOR OF THE POSITIVE COLUMN IN A MAGNETIC FIELD. C. Ekman, F. C. Hoh, and B. Lehnert (Royal Inst. of Tech., Stockholm). *Phys. Fluids* **3**, 833-4(1960) Sept.-Oct.

The effects of changes in geometry and discharge electrical-boundary conditions on the behavior of a positive column were investigated. Results indicated that the abnormal behavior observed for a cylindrical plasma column above a certain critical magnetic field still existed when the geometry of the tube walls was heavily distorted, at least in certain cases where the walls were electrically isolated. It was also found that the abnormal branch of the characteristics above the critical magnetic field could be eliminated by means of conducting plates that short circuited the ambipolar electric field. (M.C.G.)

26370

PLASMA RESONANCE IN A RADIO-FREQUENCY PROBE. K. Takayama (Electrical Communication Lab., Tokyo), H. Ikegami and S. Miyazaki. *Phys. Rev. Letters* **5**, 238-40 (1960) Sept. 15.

When the frequency of a low-voltage r-f signal superposed on a probe was swept within an adequate frequency range, the d-c component of the electron current due to the nonlinearity of the sheath impedance was measured. It was found that a resonant increase appeared in the current at the electron plasma frequency, $\omega_p = (4\pi N_0 e^2 / m)^{1/2}$, where N_0 is electron density. The relation between the frequency of r-f voltage and the corresponding d-c component of the electron current to the probe is shown. The height of the resonance peak depended not only on the magnitude of the voltage, but on the collision frequency of electrons with atoms. (M.C.G.)

26371

EVIDENCE FOR THE CONTAINMENT OF A HOT, DENSE PLASMA IN A THETA PINCH. T. S. Green (United Kingdom Atomic Energy Authority, Aldermaston, Berks, Eng.). *Phys. Rev. Letters* **5**, 297-300(1960) Oct. 1.

Measurements made of the axial containment of a plasma in a high-power linear theta pinch device are described. Observations were made of the cross-sectional area of the plasma as a function of time, using a high-speed framing camera that takes repetitive shots of the plasma at 0.25- μ sec intervals. The pinch is produced by the discharge of a 100- μ f condenser bank through a single-turn primary coil wrapped around an alumina tube containing deuterium gas at pressures of 50 to 200 μ . The investigations showed that in a narrow range of pressures a high degree of contain-

ment was achieved. Further analysis of the state shows that the plasma has a high β and a high temperature. (B.O.G.)

26372

EXPERIMENTS ON THE GROWTH RATE OF SURFACE INSTABILITIES IN A LINEAR PINCHED DISCHARGE.

F. L. Curzon, A. Folkierski, R. Latham, and J. A. Nation (Imperial Coll., London). *Proc. Roy. Soc. (London)* **A257**, 386-401(1960) Sept. 20.

Photographic observations on the growth of surface instabilities in a linear-pinch discharge are presented, and numerical results on the growth rates are deduced from them. These are discussed with reference to the various theoretical studies made. It is shown that the Rayleigh-Taylor type of instability is likely to be the dominant process and an attempt is made to compare the observed growth rates with those predicted. (auth)

26373

EXPERIMENTAL INVESTIGATION OF THE PLASMA BREAKDOWN IN MAGNETIC FIELD. V. E. Golant and A. P. Zhilinskii (Kalinin Leningrad Polytechnic Inst.). *Zhur. Tekh. Fiz.* **30**, 745-55(1960) July. (In Russian)

The results are given of an experimental investigation of plasma breakdown in helium when the diffusion of charged particles across the magnetic field is the basic breakdown mechanism. A high-frequency method was used for determining electron concentrations. The experiments were carried out at helium pressures of 0.09 to 2 mm mercury, magnetic field intensity of 1100 gauss, and charged particle concentrations of 10^8 to 10^{11} cm $^{-3}$. (tr-auth)

26374

DYNAMIC CURRENT PINCH STABILITY. V. I. Vasil'ev, V. S. Komel'kov, Yu. V. Skvortsov, and S. S. Tserevitinov. *Zhur. Tekh. Fiz.* **30**, 756-68(1960) July. (In Russian)

The formation and development of pinch currents in deuterium, hydrogen, and argon plasmas were studied. The initial gas pressure was 10 to 10^{-2} mm mercury. Maximum discharge current was 500 ka. The discharge periods varied from 20 to 300 μ sec. The plasma motion was studied by means of high-speed magnetic probes and spectral measurements. The stability of the pinch current; the current distribution; and the presence of a continuum in the emission, whose appearance in the examined area coincides with the arrival of the pinch current, were established. (tr-auth)

26375

PLASMA IN A VARYING MAGNETIC FIELD. I. M. Zolototrubov, N. M. Ryzhov, I. P. Skoblik, and V. T. Tolok (Inst. of Physics and Tech., Academy of Sciences, Khar'kov). *Zhur. Tekh. Fiz.* **30**, 769-73(1960) July. (In Russian)

Experiments were carried out with non-electrode gas discharge in the magnetic field of two single-loop coils. The discharge creates vortical electromotive forces during the variation of magnetic flux with time. The obtained plasma was subjected to a sinusoidal magnetic field which constricted it in the radial direction toward the axis of the system and in the axial direction toward the interval between the coils. Radial oscillations were observed during the constriction. (R.V.J.)

26376

ON THE NON-LINEAR THEORY OF THE ELECTRON-ION PLASMA OSCILLATIONS. F. M. Nekrasov (Khar'kov State Univ.). *Zhur. Tekh. Fiz.* **30**, 774-80(1960) July. (In Russian)

Stationary oscillations in electron-ion plasma were analyzed by applying kinetic equations. The collision integral in non-linear approximation was not considered. It was found that in cases where the electron and ion components do not have a relatively directed motion, fluctuations of the plasma charge density are controlled mainly by electrons. The ion component influences the oscillations only during relative motion. Oscillation periods are determined as functions of amplitude. Maximum fields are found where stationary waves are possible. (tr-auth)

26377

ABOUT STABILITY OF A THIN RING SHAPED PLASMA IN MAGNETIC FIELD. [PART] II. Yu. V. Vandakurov (Leningrad Inst. of Physics and Tech.). *Zhur. Tekh. Fiz.* 30, 781-9(1960) July. (In Russian)

The stability of a pinch column with surface currents and long wave perturbations (the wave length is comparable to the length of the column) was studied in magnetohydrodynamic approximation. An ideally conducting container is assumed and outer longitudinal fields are not present. (tr-auth)

26378

THE DIFFUSION OF CHARGED PARTICLES ACROSS MAGNETIC FIELD IN THREE-COMPONENT PLASMA. V. E. Golant (Leningrad Inst. of Physics and Tech.). *Zhur. Tekh. Fiz.* 30, 881-92(1960) Aug. (In Russian)

The effects of concentrations and temperature gradient on the motion of charged particles in a plasma consisting of electrons, singly charged ions, and neutral atoms were investigated. Formulas are derived for determining electron and ion fluxes across a magnetic field. (tr-auth)

26379

MAGNETIC SOUND IN THREE-COMPONENT PLASMA. D. A. Frank-Kamenetskiĭ. *Zhur. Tekh. Fiz.* 30, 893-8 (1960) Aug. (In Russian)

Formulas in the simplest approximations are developed for describing the influence of neutral particles on magnetic sound oscillations in plasma. At high frequencies the neutral gas is not entrained; whereas, at low frequencies it is completely entrained by plasma oscillations with incomplete entrainment, recharging collisions add additional damping. The influence of collisions on alternating field penetration into the plasma in the presence or absence of a strong static magnetic field is of a contrasting character (skin effect or spatial damping). (tr-auth)

26380

MAGNETO-SOUNDER RESONANCE IN PLASMA. D. A. Frank-Kamenetskiĭ. *Zhur. Tekh. Fiz.* 30, 899-906(1960) Aug. (In Russian)

Plasma resonance heating by electromagnetic energy is suggested for cases where a strong bond between the generator and plasma is secured by magnetic sound resonance. Various types of plasma resonance, subdivided into oscillating and absorption resonances, are investigated and possible magnitudes of various type resonances for plasma heating are evaluated. (tr-auth)

26381

MAGNETIC TRAP WITH ROTATING PLUGS. L. I. Rudakov. *Zhur. Tekh. Fiz.* 30, 907-12(1960) Aug. (In Russian)

Large-amplitude electromagnetic oscillations in plasma, confined in a trap by magnetic plugs, induce an additional force which prevents particles from emerging. It is shown that it is possible to close the particle escape cover by the above effect. (tr-auth)

26382

IMPROVEMENTS RELATING TO THERMONUCLEAR APPARATUS. Arthur Watson Aikin (to Metropolitan-Vickers Electrical Co., Ltd.). British Patent 838,443. June 22, 1960.

A thermonuclear reactor for inducing fusion reactions of hydrogen isotopes and removing the heat for use is designed in which a high magnetic field on the order of 10^5 gauss is produced parallel to the axis of an evacuated chamber, electrons are projected into the chamber axially, and an ionized D or T gas is projected into the chamber laterally, producing fusion. The heat is then removed by ducts in the electromagnet carrying liquid metal or gas coolant. In operation, short pulses of 1 to 10 msec are applied to the electron cathode (~ -1 kv) and to the ion source (10 to 500 kv), inducing ion currents of the order of 1 amp/cm² in the chamber, where the ion density builds up to 10^{16} to 10^{17} /cm³. Fusion occurs, either due to the individual energy of the ions or to the high effective temperature (10^8 °K for 10 kv ions). At the end of the pulse, reaction products and gas are swept away by a vacuum pump. (D.L.C.)

26383

IMPROVEMENTS IN OR RELATING TO PLASMA-CONTAINING STRUCTURES. Robert Carruthers (to United Kingdom Atomic Energy Authority). British Patent 838,551. June 22, 1960.

A gas discharge device of the toroidal type having two insulating gaps and a liner to shield the gaps from the discharge is subject to the possibility of arc spots being formed on a liner of sufficient area, whereby sufficient metal may evaporate to contaminate the plasma. To eliminate this danger, the liner is made of overlapping mutually insulated metal segments, each of area smaller than the critical area required to maintain an arc spot. (D.L.C.)

26384

IMPROVEMENTS IN OR RELATING TO GAS DISCHARGE APPARATUS. Peter Clive Thonemann (to United Kingdom Atomic Energy Authority). British Patent 848,346. Sept. 14, 1960.

A gas ring discharge apparatus for raising gases to high temperatures and employing a toroidal vessel and an axial magnetic field to confine the plasma is designed with connected ion sources for injecting into the discharge high-energy D or T-D particles in order to increase ion and electron temperatures. The ion sources contain charge exchange chambers that neutralize the charged D particles, enabling them to penetrate the magnetic field, enter the current channel, and be converted into D⁺. A suitable injection energy is ~ 0.2 Mev, and a suitable injection rate is $\sim 10^{20}$ atoms/sec. (D.L.C.)

26385

APPARATUS FOR PRODUCING AND MANIPULATING PLASMAS. S. A. Colgate, J. P. Ferguson, H. P. Furth, and R. E. Wright (to U. S. Atomic Energy Commission). U. S. Patent 2,946,914. July 26, 1960.

An electrical pinch discharge apparatus is described for producing and manipulating high-temperature plasmas. The apparatus may be of either the linear or toroidal pinch discharge type. Arrangements are provided whereby stabilizing fields may be trapped in the plasma external to the main pinch discharge path and the boundary condition of the stabilizing field programed so as to stabilize the discharge or to promote instabilities in the discharge as desired. The produced plasmas may be employed for

various purposes, and fusion neutrons have been produced with the apparatus.

Shielding

26386 NARF-60-26T

Convair, Fort Worth, Tex.

ANALYSIS OF RADIATION-INDUCED MELTING OF A LEAD SHIELD. T. W. De Vries. Aug. 8, 1960. 42p. Contract AF33(600)-38946. (MR-N-245)

A numerical method for obtaining the thermodynamic steady-state solution of a lead shield being heated from within by gamma-ray absorption and cooled by radiation and natural convection is described. The method can be used to predict radiation-heat damage to shield materials. A comparison of calculated with observed results is included. (auth)

26387 CEA-tr-R-856

BÉTON DE PROTECTION CONTRE LES RAYONNEMENTS IONISANTS. (Concrete for Protection Against Ionizing Radiation). S. (C.) A. Mironov and K. K. Ponomarev. Translated into French from Beton i Zhelezobeton 259-62 (1956). 13p.

The principles underlying the selection of materials for biological shields are reviewed, and different types of shielding concretes are described: barite concretes, magnetite concretes, concretes with limonite, ordinary concrete, and concretes with special cements. (T.R.H.)

26388

NEUTRON ABSORPTION AND SHIELDING DEVICE. I. R. Axelrad (to U. S. Atomic Energy Commission). U. S. Patent 2,942,116. June 21, 1960.

A neutron absorption and shielding device is described which is adapted for mounting in a radiation shielding wall surrounding a radioactive area through which instrumentation leads and the like may safely pass without permitting γ or neutron radiation to pass to the exterior. The shielding device comprises a container having at least one non-rectilinear tube or passageway means extending there-through, which is adapted to contain instrumentation leads or the like, a layer of a substance capable of absorbing γ rays, and a solid resinous composition adapted to attenuate fast-moving neutrons and capture slow-moving or thermal neutrons.

Theoretical Physics

26389 AFCRC-TN-60-464

New York Univ., New York. Inst. of Mathematical Sciences.

THE GREEN'S FUNCTION METHOD FOR QUANTUM CORRECTIONS TO THE THOMAS-FERMI MODEL OF THE ATOM. Gene A. Baraff and Sidney Borowitz. Aug. 1960. 35p. Project No. 2360. Contract AF19(604)-4555; DA-30-069-ORD-2581; and Nonr-285(49). (CX-50). OTS.

A systematic method is presented for deriving the Thomas-Fermi equation for an atom and the quantum corrections from the many body description. The novel feature of the method is that it does not require any a priori assumptions about the distribution of the electrons in phase space but shows instead that the distribution which is usually assumed is a direct consequence of specifying that the many-particle system is in its ground state. The procedure used in the derivation is the expansion of the mixed position-momentum representation of the Green's function in a series of powers of \hbar . The lowest order term

is found to correspond with the Thomas-Fermi density. The form of the higher order terms, which are to be considered as corrections to zeroth order term, depends on the approximations made in the many body equations for obtaining the Green's function. Only the Hartree-Fock approximation is considered, but the methods presented allow generalization to other approximations which can include correlation effects. (auth)

26390 NP-9157

Maryland. Univ., College Park.

STRICT LOCALIZATION IN QUANTUM FIELD THEORY (thesis). Physics Department Technical Report No. 187. James Milton Knight. July 1960. 57p. Contract AF49(638)-24. (AFOSR-TN-60-818).

A definition of strict localization of states in quantum field theory, based on considering products of field operators as the primary measurable quantities of the theory, is presented. It is shown that a localized state arises when a free field interacts with an external current that is limited to a bounded region of space-time. It is demonstrated by a graphical technique that a state having a finite number of particles cannot satisfy the definition of localization. (C.J.G.)

26391

THE HYDRODYNAMIC REPRESENTATION OF THE FEYNMAN AND GELL-MANN EQUATION. Jean-Claude Aron. Compt. rend. 251, 921-3(1960) Aug. 17. (In French)

A hydrodynamic representation was established for the Dirac equation, eliminating the wave functions and including only physical magnitudes. It is shown, in the present article, that a hydrodynamic representation can also be obtained for the Feynman and Gell-Mann equation. This representation, with some corrective terms, agrees with that of the Pauli and Dirac equations. (tr-auth)

26392

A PHYSICAL MODEL OF THE QUANTUM WAVE. Jean-Claude Aron. Compt. rend. 251, 992-4(1960) Aug. 22. (In French)

It has been established that the energy density derived from the Pauli equation shows an interaction between the spins of neighboring elements, tending to re-establish the parallelism. The spin fluctuations are propagated slowly by this action. In the present work, it is shown that from the hydrodynamic representation of the Dirac equation and the Feynman and Gell-Mann equation solutions can be derived which correspond to a vibration. (tr-auth)

26393

THE ATOMIC MODEL FOR PHOTRON THEORY. RELATION OF ELECTRON SHELL AND SPECTRAL TERMS. THE STRUCTURE OF THE ATOMIC NUCLEUS AND NUCLEAR POWER. K. Nowak. Neue Physik No. 4-5, 113-71(1959). (In German)

A new conception of the mechanism of atomic radiation emission is offered which does away with the contradictions of the Bohr models and agrees with the spectral series relationships. As a result it confirms a new theoretical principle for radiation energy. Further, it can be explained how only nucleons within a region of 1.4 to 0.4 Fermi seem to be attracted with great force through coulombic attraction between these and other intermediate configurations of nuclear material. (tr-auth)

26394

ARGUMENTS FOR THE PHOTRON THEORY. K. Nowak. Neue Physik No. 6, 191-9(1959). (In German)

Points of agreement of photron theory and Einstein's theories are cited and discussed. (T.R.H.)

26395

FINITE VALUE OF THE WAVE FUNCTION RENORMALIZATION CONSTANT IN QUANTUM ELECTRODYNAMICS. I. Bialynicki-Birula (Univ. of Rochester, N. Y.). *Nuovo cimento* (10) **17**, 122-3 (1960) July 1. (In English)

The existence of a class of gages which give a finite value for the electron wave function renormalization constant is discussed, and proof is given for its existence. It was found that the constant was finite in a modified Landau's gage in the second order. Proof was obtained by induction that coefficients could be chosen in such a way as to make the constant finite in every order of perturbation theory. (M.C.G.)

26396

ON THE POSSIBLE CONSEQUENCES OF A VARIABILITY OF THE ELEMENTARY CHARGE. F. Hoyle (Univ. of Cambridge, Eng.). *Proc. Roy. Soc. (London)* **A257**, 431-42 (1960) Sept. 27.

The cosmological effects of a slight difference of charge between the proton and electron were considered. It is shown that in order to obtain a steady-state solution of the cosmological equations, the terms by which Maxwell's equations are modified must be of an opposite sign to that considered recently by Lyttleton & Bondi. The change of sign has the effect of altering the Coulomb law of force between charges at large distances apart, in such a way that unlike charges repel while like charges attract. In the steady-state solution the mean spatial density of matter is such that the electrostatic potential is of an opposite sign to that which would be given by Coulomb's law. In this situation the charges are in fact attractive, not repulsive as considered by Lyttleton & Bondi. The effect of creation of matter in pairs is considered. It appears that the change of Coulomb's law might be used to separate matter and anti-matter. The process of separation produces an electric current, leading to the existence of an intergalactic magnetic field. (auth)

26397

LECTURES IN THEORETICAL PHYSICS. VOLUME II. Lectures Delivered at the Summer Institute for Theoretical Physics, University of Colorado, Boulder, 1959. Wesley E. Brittin and B. W. Downs, eds. New York, Interscience Publishers, Inc., 1960. 489p. \$9.00.

The lectures were presented at the University of Colorado, Boulder, June 15 to August 21, 1959. Topics covered by the lectures were: invariance properties, symmetry, and interactions in elementary particle physics; hypernuclei and Λ -nucleon interactions; classical electrons; amplifiers and many body problems in quantum mechanics; abstract field theory; and problems in β -decay theory. Separate abstracts were prepared for each of the lectures. (B.O.G.)

REACTOR TECHNOLOGY**General and Miscellaneous****26398** AEEW-R-25 and Add.

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Establishment, Winfrith, Dorset, England.

RESONANCE INTEGRAL CALCULATIONS FOR HIGH TEMPERATURE REACTORS. J. P. H. Blake. Feb. 1960. 48p. Includes Addendum: Apr. 1960. BIS.

Methods of calculation of resonance integrals of finite dilution and temperature are given for both homogeneous and heterogeneous geometries, together with results ob-

tained from these methods as applied to the design of high-temperature reactors. (auth)

26399 AERE-R-3364

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

A PROGRAMME FOR THE EVALUATION OF RESONANCE ESCAPE PROBABILITIES AND SELF-SHIELDING FACTORS IN HYDROGEN MODERATED LATTICES. A. J. Taylor. June 1960. 20p. BIS.

An approximate method for the evaluation of resonance escape probabilities and self-shielding factors in heterogeneous systems is developed. Scattering by light elements which may be present in the fuel is taken into account. Resolved resonances are treated individually and an estimate of the contribution of the unresolved resonances is made. The effect of Doppler broadening of the resonances is estimated. Results for a few cases are compared with results obtained by Monte Carlo and semiempirical methods. There is good agreement with Monte Carlo results for resolved resonances, but the estimate of the contribution of unresolved resonances to the absorption does not agree well with other results. (auth)

26400 BAW-307

Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.

CONTROL BLADE WORTH BY PARTIAL WATER HEIGHT AND SOLUBLE BORON METHODS. Arland L. MacKinney and Russell M. Ball. July 1960. 19p. Contract [AT(30-3)-274]. OTS.

Presented orally as Paper 20-7 of the Summer 1959 Meeting of the American Nuclear Society in Gatlinburg, Tennessee.

Evaluations of fully inserted patterns of cruciform control blades were made in slightly enriched, ordinary-water-moderated cores. A curve of differential reactivity with water height, dp/dh vs. h , was measured. This curve is integrated to develop a plot of reactivity as a function of water height. Using the integral curve and the measured water height for the various blade patterns, the reactivity associated with fully inserted blades may be determined. For single-zone cores, the experiments showed that the value of dp/dh was the same for a particular water height and was independent of the pattern of blades which was chosen to give that reactivity. In an assembly of 4% enriched UO_2 pins clad with stainless steel and arranged in can lattices, the measurements indicated that the function dp/dh vs. h was also insensitive to the thickness of the stainless-steel or aluminum can walls. Soluble-boron experiments were performed by inserting a small amount of boric acid into the water moderator-reflector, and measuring its associated reactivity change. These measurements, repeated at various concentrations, yielded a curve of the reactivity coefficient of boric acid as a function of concentration and integral curve of boric acid reactivity. All boric acid measurements were made at full water height. The boric acid concentrations were determined by a potentiometric titration method. Measurements of accurately prepared solutions yielded a standard deviation of 0.7% with an average different from the prepared solution of 0.6%. (auth)

26401 GAMD-63(Rev.) and Add. 1,2,3

General Atomic Div., General Dynamics Corp., San Diego, Calif.

BUNNY. A TWO-GROUP, TWO-REGION REACTOR CODE FOR SPHERICAL SYSTEMS. Robert Karplus. June 7, 1957. Addenda: [No. 1]. Virginia Nather. Sept. 24, 1957. No. 2. MODIFICATIONS FOR THE GA BUNNY CODE.

JACK RABBIT. Virginia Nather. Dec. 3, 1957. No. 3. FURTHER MODIFICATION OF THE GENERAL ATOMIC BUNNY CODE. BALANCED BUNNY. E. K. Booth. Mar. 17, 1959. 59p. Project No. 1.

The program is designed to solve the two-group, two-region neutron-diffusion problem. A set of reactor parameters is found which describes a stationary chain-reacting system. All but one of these parameters are provided by the input; the last one is found so as to make the critical determinant vanish. If several sets of input data are supplied, a critical reactor is found for each one. The reactor parameters are used to find the fluxes, the adjoint fluxes, and some other useful results. (auth)

26402 GEAP-3344

General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.

A METHOD FOR THE COMPARATIVE EVALUATION OF REACTOR CONTROL MATERIALS. T. J. Pashos, G. D. Ritland, and J. L. Russell, Jr. Apr. 13, 1960. 16p. Contract AT(04-3)-189. OTS.

A method of comparing the approximate nuclear worth and reactivity life of various neutron-absorber materials is described. It is intended that someone relatively unfamiliar with reactor physics can use this method for an approximate comparison of nuclear-reactor control materials. The method is applicable to thermal reactors with slab type control elements. It is not suitable for comparing control materials when used in rectangular or cylindrical rod geometries. The use of this calculation method is demonstrated in a typical reactor application. This illustrative example used the control system of the Argonne Experimental Boiling Water Reactor as a model. (auth)

26403 HW-61204

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

COFIT—A 709 PROGRAM FOR DETERMINING EXTRAPOLATION LENGTH FROM HORIZONTAL TRAVERSE DATA. D. D. Matsumoto. Aug. 11, 1959. 15p. Contract AT(45-1)-1350. OTS.

An IBM-709 program was written which will determine extrapolation length from horizontal traverse flux measurements taken in an exponential pile. One- or two-region end and harmonic corrections can be computed, depending on input specifications. (C.J.G.)

26404 HW-62531

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

EFFECT OF THE PRTR HIGH PRESSURE LOOP ON PLUTONIUM RECYCLE PROGRAM OBJECTIVES. R. E. Peterson. Oct. 20, 1959. 11p. Contract AT(45-1)-1350. OTS.

A study of the effects of a high-pressure water loop on the Plutonium Recycle Program was conducted. Consideration was given to reactivity of PRTR, program schedules, and physics analysis and data. Reactor startup, safety, and operation were also considered. Although these considerations are evaluated separately, none of the items are completely independent of the others. (J.R.D.)

26405 KAPL-M-DBM-1(Rev.1)

Knolls Atomic Power Lab., Schenectady, N. Y. SOURCELESS STARTUP. A MACHINE CODE FOR COMPUTING LOW-SOURCE REACTOR STARTUPS. D. B. MacMillan. June 1, 1960. Revised Aug. 3, 1960. 6p. Contract W-31-108-Eng-52. OTS.

A revision to the sourceless start-up code is presented. The code solves a system of differential equations encountered in computing the probability distribution of

activity at an observed power level during reactor start-up from a very low source level. (J.R.D.)

26406 KAPL-M-D1G-TD-13

Knolls Atomic Power Lab., Schenectady, N. Y. SPY (D1G), AN IBM-704 DIGITAL COMPUTER PROGRAM FOR THE CALCULATION OF NUCLEAR REACTOR THERMAL TRANSIENTS. I. R. Goodwin, C. H. Hunt, D. C. Maxwell, and R. B. Taylor. June 10, 1960. 131p. Contract W-31-109-Eng-52. OTS.

SPY (D1G) is an IBM-704 digital-computer program developed specifically for the calculation of thermal transients occurring in a three primary coolant loop, one-pass nuclear reactor system. The program has the computing ability to provide the supporting calculations for the analysis of complete and sequential loss-of-flow accidents, cold-water accidents, start-up accidents, and other accidents which may be simulated by externally controlled variations in reactivity. Inclusion of a three-channel core model and the effects of interchannel flow redistribution provide a basis for the complete transient thermal analysis of both nominal and hot channels. Two versions of the program are available: SPY 1 employing three radial nodes and SPY 2 employing six radial nodes to describe the thermal transient effects in terms of fuel-element meat, cladding, and surface temperatures, and bulk-coolant temperatures. Each version contains an option for eliminating all thermal and hydraulic calculations in one of the three channels. Operation of the program requires an IBM-704 digital computer of 16,000-word minimum core storage. (auth)

26407 MND-1687-1

Martin Co. Nuclear Div., Baltimore. ADDENDUM TO SLAB CELL CORRECTING PROGRAM. ADDENDUM TO NUCLEAR ENGINEERING TECHNICAL MEMORANDUM NO. 21. D. H. Frederick and E. A. Schaefer. Aug. 7, 1959. 18p.

Modifications to the original slab-cell correction program for punching cell corrections as used by program C-3 are contained. The only changes are in card one which became a hollerith card and in card two which contains the fluxes and control words. The program is referred to as SCCC-2. (C.J.G.)

26408 NAA-SR-5409

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

EXPONENTIAL EXPERIMENTS WITH GRAPHITE-MODERATED URANIUM-METAL LATTICES. R. W. Campbell and R. K. Paschall. Sept. 15, 1960. 32p. Contract AT-11-1-GEN-8. OTS.

Measurements of material buckling and intracell flux distributions were made in eight uranium-graphite exponential assemblies constructed from combinations of three square-cell sizes (7-, 9.5-, and 12-in.) and three enrichments (0.4962, 0.7205, and 0.9124 a/o) of 1-in.-diameter uranium metal fuel rods. Data from these assemblies in conjunction with single-element experiments indicate that the maximum buckling for the enriched fuel was approximately 4.65 m^{-2} at a 5.6-in. lattice spacing. Intracell thermal-flux distributions agreed to within 2 or 3% of values obtained from the S_4 approximation of the transport equation although the theory showed a systematically larger flux depression in the more highly enriched fuel, perhaps owing to neglect of spectral hardening. Resonance-escape probabilities were measured for the three lattice spacings of natural (0.7205 at. % U^{235}) fuel. The average value obtained for the effective resonance integral for U^{238} was 10.02 ± 0.40 barns. This value is in close agreement with a value of 9.77 barns obtained from the empirical formula $I = 27.8\sqrt{S/M} + 0.04$, deduced from Hellstrand's data. (auth)

26409 NDA-Memo-2136-3

Nuclear Development Corp. of America, White Plains, N. Y. OPERATIONAL PROCEDURES AND SOME ACCIDENT ANALYSES FOR THE ORNL FAST BURST REACTOR. G. Breidenbach, A. Krumbein, and F. Nakache. June 30, 1960. 20p. For Oak Ridge National Lab. Contract 93X-81334-C. OTS.

Operational procedures for burst and steady-state power operation are outlined in detail. In addition the procedure for the initial approach to criticality is described. Two possible reactor accidents were analyzed. These included: (1) failure of all mechanical scram devices to operate after a burst, and (2) a "maximum credible" accident in which the reactor is dropped from some height onto a concrete floor, becoming instantly assembled into a maximum-reactivity configuration upon impact with the floor. Analysis of the first accident indicates that melting of a portion of the reactor may occur. The second accident results in an excursion amounting to $\sim 10^{18}$ fissions. This is expected to destroy the core and possibly result in damage to the reactor building. The maximum instantaneous radiation dose to personnel in the control building, $\frac{1}{4}$ mile away from the reactor, is not expected to exceed 1 rem. The subsequent dose to personnel from a fission product cloud is shown. It can be seen that the external β and fission-product inhalation doses from this source are quite large if the cloud passes at ground level directly over an unprotected individual. For an individual inside a closed building, these dose rates will be drastically reduced. In addition, since the dose falls off rapidly with cloud height, it is highly unlikely that any personnel located indoors (at $\frac{1}{4}$ mile from the reactor) will receive a serious radiation dose. The inhalation hazard due to vaporized uranium was found to be negligible at $\frac{1}{4}$ mile from the accident site even under the most pessimistic conditions. (auth)

26410 TID-3525(Rev.2)

Office of Technical Information Extension, AEC. REACTOR SAFETY. A Literature Search. Richard J. Smith, comp. Sept. 1960. 72p. OTS.

References to 411 unclassified AEC research and development reports and 151 unclassified non-AEC reports are included in this bibliography. Reactor systems, materials, and operation designed to provide maximum safety for the reactor, reactor personnel, and environs are included. Information is presented concerning incidents and conditions of operation considered hazardous. (auth)

26411 UCRL-5665(p.127-39)

Knolls Atomic Power Lab., Schenectady, N. Y. A PULSED NEUTRON TECHNIQUE FOR REACTIVITY DETERMINATION. B. E. Simmons.

The problems of interpretation of pulsed-source measurements on control-rod systems in H_2O moderated and reflected reactors are discussed. A brief description of the KAPL experimental arrangement is given. The 256-channel analyzer and the detectors are described. (W.D.M.)

26412 AEC-tr-4178

France. Commissariat à l'Énergie Atomique, [Paris]. REPORT ON THE THERMAL DISTORTION OF FUEL ELEMENTS IN A CLUSTER. (Note sur la Distorsion Thermique des Elements de Combustible en Grappe). B. Bailly du Bois. Translated from a publication of the French Atomic Energy Commission, Aug. 8, 1959. 12p. JCL or LC.

An amplification mechanism of thermal distortion of fuel elements in a cluster is described by considering the suc-

cessive phases of expansion with "positive feedback." (C.J.G.)

26413 CEA-tr-A-406

CALCUL ÉLECTRONIQUE POUR LA CONSTRUCTION DE RÉACTEURS. (Electronic Calculations for Reactor Construction). V. Putter. Translated into French from *Atomkernenergie* 2, 319-20(1957). 6p.

A brief survey is presented of computer development, and computer applications in reactor engineering are discussed. (T.R.H.)

26414 NP-tr-483

TESTING OF METAL SHELLS INTENDED TO CONTAIN THE RADIOACTIVE GASES IN THE EVENT OF REACTOR ACCIDENTS. F. R. Belot and M. Melice. Translated by S. Pease (U.K.A.E.A. Atomic Energy Research Establishment) from p.213-41 of "VI Rassegna Internazionale Elettronica e Nucleare." Atti Del Congresso Scientifico, Giugno 1959. A publication of Comitato Nazionale Ricerche Nucleari, Rome. 47p. (Handwritten MS. Copy). JCL.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 14, as abstract No. 9629.

26415

THE GENERALIZED NYQUIST DIAGRAM AND ITS APPLICATION TO THE STUDY OF REACTOR STABILITY. A. Blaquiere (Institut National des Sciences et Techniques Nucleaires, Saclay, France). *Bull. inform. sci. et tech.* (Paris) No. 41, 2-13(1960) June. (In French)

The Nyquist method, introduced for feed-back loops, may be generalized and is particularly adaptable to the study of nonlinear loops. The method introduced for tube oscillators is reviewed, and it is shown how it can be applied to the study of reactor stability. The basis of the method is the replacement of the analytical function $H(j\omega)$, in which the parameter ω is the operating frequency (used by Nyquist to describe the operation of a feed-back loop), with the more complete function $H(a, j\omega)$, in which a is the amplitude. It is then easy to see how the Nyquist method is generalized. In the linear case, the representation on the complex plane of the function $H(j\omega)$, obtained by varying the real parameter ω from $-\infty$ to $+\infty$, is a curve, the position of which in relation to the origin shows if the operating conditions are stable or unstable. In the nonlinear case, the same graphic method leads to a family of curves dependent on the amplitude parameter. According to the amplitude value, the system is then stable or unstable. The stability limits are defined, and the limiting amplitudes are fixed. In the case of nuclear reactors the pulse ω is fixed by a sinusoidal variation imposed on the reactivity. The amplitude is defined by the power level at which the operation is carried out. (tr-auth)

26416

EDGE CONDITIONS IN CALCULATION OF NEUTRON FLUX IN THE UNIT CELL ACCORDING TO TWO-GROUP METHODS. H. Hessel (Zentralinstitut für Kernphysik, Rossendorf, Ger.). *Kernenergie* 3, 613-17(1960) July. (In German)

In calculating the neutron flux in the unit cell of a reactor by multigroup methods, the question arises as to how the conditions at the edge of the shell must be chosen in order to obtain a system of equations without discrepancies. Two methods are described which set all groups in the neutron current at the edge at zero and one method is described which considers the escape of neutrons from the unit cell. The different methods are then compared as to applications and results. (tr-auth)

26417

REACTIVITY LIFE OF NATURAL U. Arthur G. Ward (Atomic Energy of Canada Ltd., Chalk River, Ont.). *Nucleonics* 18, No. 10, 69-72(1960) Oct.

One of the most important results of an extensive program of physics measurements and calculations for CANDU is the prediction of reactivity lifetime of natural-uranium fuel. Good estimates of fuel lifetime are needed to calculate a realistic value for fueling costs. Since June 1959, when the first reference design of CANDU was set, results of calculations ranged from 8,800 Mwd/ton to 10,600 Mwd/ton; from which, the original prediction was $9,750 \pm 10\%$ Mwd/ton. Refined lifetime calculations and available experimental data reaffirm this prediction. (B.O.G.)

26418

REACTOR SAFETY IN CANADA. George C. Laurence (Atomic Energy of Canada Ltd., Chalk River, Ont.). *Nucleonics* 18, No. 10, 73-7(1960) Oct.

Protection against reactor accidents in Canada does not differ greatly from practice in the United States and the United Kingdom. The awareness of the cost of safety measures has brought about a necessity for re-examining safety requirements. A need to express the risks quantitatively is asserted, even if the limits of uncertainty in the estimates are several orders of magnitude. To calculate an acceptable risk for nuclear reactors, start by multiplying the risk in deaths per year for all industry by the ratio of the annual investment in reactors to the annual investment in other industry. The operating experience with reactors is still insufficient to give the statistics needed for a precise estimate of probable future casualty rate. Duplicate components and continuous testing lead to the perfection needed for a reliable reactor safety system. (B.O.G.)

26419

VERSATILE DATA DISPLAYS FOR REACTORS. C. G. Lennox and A. Pearson (Atomic Energy of Canada, Ltd., Chalk River, Ont.). *Nucleonics* 18, No. 10, 82; 84; 132 (1960) Oct.

The size and complexity of modern reactors demand, and modern data-processing techniques make possible, a new order of data presentation for the reactor operator. The operator wants to be able to measure many variables continuously, store the results, and have them available as required, in any of several easily interpreted display modes. It is believed that by choosing appropriate data storage and by giving thought to the amount of reactor history that must be kept, not only can the task of "looking back" be simplified but a new tool becomes available to aid the operator in assessing plant conditions. If a rapid-access store that is independent of any display can be made feasible, then electronic means can be used to search the store and display the data in any of several forms. Two display systems are being examined in conjunction with an experimental 32-point system. The first display is based on the familiar strip-chart-recorder technique; the second is a geometric display which can be synthesized from data recorded on a drum. Both types of display are illustrated. (B.O.G.)

26420

DIGITAL COMPUTERS AND NUCLEAR REACTOR CALCULATIONS. Ward C. Sangren. New York, John Wiley & Sons, Inc., 1960. 215p. \$8.50.

The book, which serves as an introduction to high-speed reactor calculations, is intended for the practicing engineer or scientist. Computers, programming, numerical analysis, codes for fission product poisoning, diffusion and

age calculations, transport equation, and reactor calculations are discussed. A rather complete discussion of a specific reactor calculation is given, and a number of representative types of calculations is considered briefly. (W.D.M.)

26421

IMPROVEMENTS RELATING TO CHARGE CHUTES FOR ATOMIC REACTORS. Arthur Shillitto, Dennis Michael Watts, and Kenneth Arthur Billingham (to English Electric Co., Ltd.). British Patent 838,292. June 22, 1960.

A charge chute for refueling reactors is described in which the fuel elements at no time are subjected to a sudden angular change in the direction of movement such as is encountered going around corners. (D.L.C.)

26422

IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Anthony Maurice Cocks (to A.E.I.-John Thompson Nuclear Co., Ltd.). British Patent 838,450. June 22, 1960.

A fuel-element arrangement for gas-cooled graphite-moderated reactors is given in which each channel is not filled up to its capacity with elements but rather filled in such a way that, in a group of adjacent channels, only one element is present on one level and the next level's element is in a different channel than the first. The advantages of this arrangement are that less gas flow is required for the same fuel heat rating along with a smaller channel and that heat transfer is improved for finned elements since the fins can then extend from the can to the channel periphery without obstructing the gas flow. The channels may either be formed in the moderator itself or in graphite blocks, which can be lifted out of the reactor together with their elements. (D.L.C.)

26423

MONITORING SYSTEM. (to Atomic Energy of Canada, Ltd.). British Patent 838,912. June 22, 1960.

A monitoring scheme for reactor fuel channels is given which reduces the number of detectors needed and consists of connecting each channel to a combination of at least two detectors, each combination being different from all other combinations. The equation for the number of channels that may be monitored in this way is $y!/(y-z)!z!$, where y is the total number of detectors and z is the number of detectors per combination for each channel. An example is discussed in which $y = 22$ detectors and $z = 2$, giving a total of 231 fuel channels which may be monitored by 22 detectors, taken two at a time. Another advantage of this scheme is that it is proof against unknown detector failures, since it is very unlikely that two or more detectors (the number corresponding to z) will fail simultaneously. (D.L.C.)

26424

IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Derek Randall Smith and Donald Francis Binns (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 840,333. July 6, 1960.

Gas-cooled reactors can be designed to permit on-load refueling without the danger of the last fuel element being blown out; this is done by increasing the cross-sectional area of the coolant path at the entrance of the channel. This increase is brought about by either reducing the fin diameter of one or more fuel elements at the end of the channel or increasing the channel diameter at the bottom over a distance equal to or greater than the length of a fuel element. (D.L.C.)

26425

IMPROVEMENTS RELATING TO NUCLEAR REACTORS.

John Jeffrey Stubbs and Terence Ingham (to English Electric Co., Ltd.). British Patent 846,865. Aug. 31, 1960.

A moderator-structure design for graphite-moderated reactors is given which comprises transversely spaced columns of elongated graphite blocks with fuel channels extending horizontally lengthwise through the blocks of each column and displaced from the longitudinal axes of the blocks in such a way that the fuel channels in any one column are axially aligned. The blocks are held in position by mating graphite-locating pegs, and their arrangement gives a square lattice of fuel channels but offers no straight passage between the blocks, thereby reducing neutron streaming. Vertical control rod channels are formed in a square lattice by milling out quadrants in some of the block corners or semicircular recesses in the sides of some of the blocks. (D.L.C.)

26426

IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Donald Mason Sutherland and Philip Rawson Tipper (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 846,923. Sept. 7, 1960.

A device for loading and unloading fuel elements in reactors is designed which is of the grab type and has at the lower end claws rotatable about a vertical axis so as to be movable in or out of engagement with a fuel-element carrier. Pulleys operate the claws through a Geneva type mechanism. The device is intended for use in reactor fuel passages with guide grooves for orienting the fuel elements. (D.L.C.)

26427

IMPROVEMENTS RELATING TO SHOCK-ABSORBING DEVICES. Hubert Henry Heath and Reginald Harold Rout (to English Electric Co., Ltd.). British Patent 847,079. Sept. 7, 1960.

A shock-absorbing device is described which may be attached to the lower end of a reactor control rod or at the bottom of a control rod or fuel-element channel. The device comprises a telescopic tubular housing containing a plunger with screw threads. If the control rod has enough kinetic energy, the threads will strip, causing the housing to move downward relative to the plunger. If the control rod is dropped a second time and the housing-plunger movement has reached its limit, the telescopic sections of the housing will shear their grub screws and allow a further length of the thread to be stripped. (D.L.C.)

26428

IMPROVEMENTS IN OR RELATING TO MODERATOR STRUCTURES FOR NUCLEAR REACTORS. Ronald Scott Challender and Dennis Ross Poulter (to United Kingdom Atomic Energy Authority). British Patent 847,122. Sept. 7, 1960.

A moderator-structure design for sodium-cooled graphite-moderated reactors having re-entrant cooling systems is given which allows for thermal and irradiation growth of its columns of graphite blocks without undue stress on the structure. (D.L.C.)

26429

IMPROVEMENTS IN OR RELATING TO COOLING SYSTEMS FOR NUCLEAR REACTORS. Sydney Fawcett (to United Kingdom Atomic Energy Authority). British Patent 847,123. Sept. 7, 1960.

A means of improving reactor cooling systems is outlined in which the moderator structure, in addition to fuel channels, has vacant channels with throttling means for producing a temperature rise larger than that through the fuel channels. The advantage of this rise difference is that

the moderator near the fuel is at a low temperature so that the neutron energies are kept low while the moderator remote from the fuel is at a higher temperature, thereby reducing neutron absorption. One concrete example of such a cooling arrangement is discussed in which N_2 coolant issuing from the fuel and vacant channels is at 400 and 470°C, respectively, giving a resultant temperature of 450°C on mixing. When zirconium tubes are used in the fuel channels to furnish re-entrant cooling, the tubes are not subjected to temperatures above 400°C where reaction with N_2 may occur while a working gas at 450°C is obtained. (D.L.C.)

26430

IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Richard Valentine Moore and August Rounph (to United Kingdom Atomic Energy Authority). British Patent 847,124. Sept. 7, 1960.

A fuel-element arrangement for reactors with re-entrant cooling systems is designed in the form of seven fuel-rod clusters housed in sleeves which are stacked one upon another to form a continuous tube. After a certain amount of reactor operation, the sleeves are withdrawn and rearranged in order to extend the fuel-element lifetime and enable the reactor to be subjected to a higher mean irradiation. (D.L.C.)

26431

IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Richard Valentine Moore (to United Kingdom Atomic Energy Authority). British Patent 847,125. Sept. 7, 1960.

A fuel element arrangement for reactors with re-entrant cooling systems is designed which reduces the pressure drop of the coolant as it flows from the outer channel into the inner channel containing the fuel elements. This reduction is effected by perforated sleeves enclosing the fuel elements and forming the outer annular and inner channels for re-entrant cooling. The fuel elements are arranged in seven-rod clusters. (D.L.C.)

26432

IMPROVEMENTS IN AND RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Andrew Thomson Bowden and John MacIntyre Robertson (to C. A. Parsons & Co., Ltd.). British Patent 847,216. Sept. 7, 1960.

A fuel element arrangement for graphite-moderated reactors is designed in which the canned fuel element is housed in, but spaced from, a graphite tube in such a way that a plurality of such elements can be stacked up in a channel without placing stress on the fuel or its canning; the stresses are taken up by the graphite tubes. The space between the moderator and the tube and the space between the tube and the element are open to coolant flow. When the fuel elements are replaced, the graphite tubes can also be replaced; this is of advantage in CO₂-cooled reactors where graphite-CO₂ reactions can occur. The moderator is also kept at a low temperature level. (D.L.C.)

26433

IMPROVEMENTS IN OR RELATING TO HEAT EXCHANGE ELEMENTS SUITABLE FOR USE AS FUEL ELEMENTS FOR NUCLEAR REACTORS. Heinrich Hugo Ludolf Ritz (to C. A. Parsons & Co., Ltd.). British Patent 847,220. Sept. 7, 1960.

A heat exchange element is designed comprising two or more helically finned tubular members arranged in an enclosing tube and may be used as a fuel-element arrangement in graphite-moderated reactors with the fuel elements as the finned tubes and a graphite tube as the enclosing

tube. The graphite tube is spaced from both the moderator and the fuel elements to permit coolant flow therein.

(D.L.C.)

26434

IMPROVEMENTS IN OR RELATING TO MANIPULATING MACHINES FOR NUCLEAR REACTORS. Sydney Fawcett (to United Kingdom Atomic Energy Authority). British Patent 847,273. Sept. 7, 1960.

A manipulating machine for discharging fuel elements from a reactor is designed which forms part of the gamma shielding of the reactor and which prevents the fuel elements from overheating owing to fission products. The machine is capable of discharging the reactor while it is operating, and it circulates within itself a coolant which is the same as the primary coolant, limiting the temperature rise inside the machine to 20°C above ambient condition. This machine is of special applicability to sodium-cooled reactors. (D.L.C.)

26435

IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR REFUELLING DEVICES. Stanley Hackney and Gordon Packman (United Kingdom Atomic Energy Authority). British Patent 847,636. Sept. 14, 1960.

A reactor refueling device was invented which has rods that are rotatable about their axes with passageways connected to fuel channels so that, by rotating a rod, its passageway can be positioned in connection to one of the pipes allowing refueling of a fuel channel. The device also provides a restraint load on the moderator structure parallel to the fuel channels. A configuration of a graphite-moderated gas-cooled reactor using the device is shown. (D.L.C.)

26436

IMPROVEMENTS RELATING TO TEMPERATURE MEASURING APPARATUS FOR FUEL ELEMENTS OF NUCLEAR REACTORS. Charles Herbert Quinton Flfield, Derek Randall Smith, and John Albert Robinson (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 847,696. Sept. 14, 1960.

A thermocouple arrangement for temperature measurements in fuel elements of graphite-moderated gas-cooled reactors is given in which one or more thermocouples are installed in the canning metal of a fuel element with electrical leads between the thermocouples and contact plungers carried on ceramic blocks interposed between adjacent graphite blocks. (D.L.C.)

26437

MEANS AND METHOD OF CHANGING THE NEUTRON DENSITY CURVE ACROSS A NUCLEAR REACTOR. Gale Jay Young. British Patent 847,902. Sept. 14, 1960.

A reactor is designed with varying moderator-fuel volume ratios so that the neutron reproduction ratio is lower in the central zone than in the rest of the core; this leads to a relatively flat neutron density curve. The advantage of this flat neutron density curve is that the generated heat is spread out over a large reactor volume, so that operating power can be increased without damage to the reactor. This is a particular advantage in reactors for converting U^{238} into Pu^{239} because production can be increased and made more uniform throughout the reactor. A configuration of a graphite-moderated air-cooled reactor using uranium is described in detail. (D.L.C.)

26438

IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR MODERATOR STRUCTURES. William Rodwell (to

United Kingdom Atomic Energy Authority). British Patent 847,945. Sept. 14, 1960.

A reactor moderator-reflector structure can be restrained from movement due to acceleration as in ships while allowing for dimensional changes during the reactor lifetime by the use of a restraint band surrounding the structure and comprising a series of shoes pivoted on members that, when rotated, forces the shoes against the structure. (D.L.C.)

26439

IMPROVEMENTS RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Alfred Zelma Keller and Derek Randall Smith (to A.E.I.-John Thompson Nuclear Energy Co., Ltd.). British Patent 848,127. Sept. 14, 1960.

A fuel-element canning design with helical fins is given which reduces stresses in the canning owing to unequal thermal expansion of magnesium and uranium and consequent ratchetting by making the fins smaller and more closely spaced on the ends of the can for a distance, λ , over which the stresses decay rapidly to a low value. (D.L.C.)

26440

HIGH TEMPERATURE, HIGH POWER HETEROGENEOUS NUCLEAR REACTOR. R. P. Hammond, W. R. Wykoff, and H. M. Busey (to U. S. Atomic Energy Commission). U. S. Patent 2,940,915. June 14, 1960.

A heterogeneous nuclear reactor is designed comprising a stationary housing and a rotatable annular core being supported for rotation about a vertical axis in the housing, the core containing a plurality of radial fuel-element supporting channels, the cylindrical empty space along the axis of the core providing a central plenum for the disposal of spent fuel elements, the core cross section outer periphery being vertically graduated in radius one end from the other to provide a coolant duct between the core and the housing, and means for inserting fresh fuel elements in the supporting channels under pressure and while the reactor is in operation.

26441

METHOD OF PREPARING A FUEL ELEMENT FOR A NUCLEAR REACTOR. W. E. Roake, E. A. Evans, and D. W. Brite (to U. S. Atomic Energy Commission). U. S. Patent 2,941,933. June 21, 1960.

A method of preparing a fuel element for a nuclear reactor is given in which an internally and externally cooled fuel element consisting of two coaxial tubes having a plurality of integral radial ribs extending between the tubes and containing a powdered fuel material is isostatically pressed to form external coolant channels and compact the powder simultaneously.

26442

CATALYTIC RECOMBINER FOR A NUCLEAR REACTOR. L. D. P. King (to U. S. Atomic Energy Commission). U. S. Patent 2,943,921. July 5, 1960.

A hydrogen-oxygen recombiner is described for use with water-boiler type reactors. The catalyst used is the well-known platinized alumina, and the novelty lies in the structural arrangement used to prevent flashback through the gas input system. The recombiner is cylindrical, the gases at the input end being deflected by a baffle plate through a first flashback shield of steel shot into an annular passage adjacent to and extending the full length of the housing. Below the baffle plate the gases flow first through an outer annular array of alumina pellets which serve as a second flashback shield, a means of distributing the flowing gases evenly and as a means of reducing radiation losses to the

walls. Thereafter the gases flow into the centrally disposed catalyst bed where recombination is effected. The steam and uncombined gases flow into a centrally disposed cylindrical passage inside the catalyst bed and thereafter out through the exit port. A high rate of recombination is effected.

26443

NEUTRONIC REACTOR OPERATIONAL METHOD AND CORE SYSTEM. C. E. Winters, C. B. Graham, J. S. Culver, and R. H. Wilson (to U. S. Atomic Energy Commission). U. S. Patent 2,945,794. July 19, 1960.

Homogeneous neutronic reactor systems are described wherein an aqueous fuel solution is continuously circulated through a spherical core tank. The pumped fuel solution is injected tangentially into the hollow spherical interior, thereby maintaining vigorous rotation of the solution within the tank in the form of a vortex; gaseous radiolytic decomposition products concentrate within the axial vortex cavity. The evolved gas is continuously discharged through a gas-outlet port registering with an extremity of the vortex cavity, and the solution stream is discharged through an annular liquid outlet port concentrically encircling the gas outlet by virtue of which the vortex and its cavity are maintained precisely axially aligned with the gas outlet. A primary heat exchanger extracts useful heat from the hot effluent fuel solution before its recirculation into the core tank. Hollow cylinders and other alternative core-tank configurations defining geometric volumes of revolution about a principal axis are also covered. AEC's Homogeneous Reactor Experiment No. 1 is a preferred embodiment.

26444

LOADING AND UNLOADING DEVICE. M. Treshow (to U. S. Atomic Energy Commission). U. S. Patent 2,949,202. Aug. 16, 1960.

A device for loading and unloading fuel rods into and from a reactor tank through an access hole includes parallel links carrying a gripper. These links enable the gripper to go through the access hole and then to be moved laterally from the axis of the access hole to the various locations of the fuel rods in the reactor tank.

26445

SELF-REGULATING BOILING-WATER NUCLEAR REACTORS. J. A. Ransohoff and J. D. Plawchan (to U. S. Atomic Energy Commission). U. S. Patent 2,949,414. Aug. 16, 1960.

A boiling-water reactor was designed which comprises a pressure vessel containing a mass of water, a reactor core submerged within the water, a reflector tank disposed within the reactor, the reflector tank being open at the top to the interior of the pressure vessel, and a surge tank connected to the reflector tank. In operation the reflector level changes as a function of the pressure within the reactor so that the reactivity of the reactor is automatically controlled.

26446

CONCENTRIC TUBULAR FUEL ELEMENT. C. W. Wheelock (to U. S. Atomic Energy Commission). U. S. Patent 2,949,416. Aug. 16, 1960.

An improved fuel element for an organic-moderated reactor was designed that comprises an inner and an outer container tube, a plurality of spaced, concentric fuel tubes positioned between the container tubes, each of the fuel tubes comprising a core of fissionable material with cladding on the sides thereof, each of the sides having a plurality of fins, the fuel tubes and the container tubes

defining annular spaces for coolant flow, and the inner container tube defining a channel for a reactor moderator.

Power Reactors**26447** AECU-4701(Pts. 1 and 2)

Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif. and Allis-Chalmers Mfg. Co. Nuclear Power Dept., Washington, D. C.

EXPERIMENTAL GAS COOLED REACTOR. PART 1. PRELIMINARY PROPOSAL. PART 2. PRELIMINARY PROPOSAL DRAWINGS (APPENDIX C). Aug. 1959. (Part 1, 154p.; Part 2, 99p.). Contract AT(10-1)-925. OTS.

These two parts were issued separately, but are cataloged as a unit.

A summary is given for the conceptual design study (Title I Design Report) on the Experimental Gas Cooled Reactor under construction in Clark Ridge. A thorough description of the project and the various parts of the reactor is given, as well as problems to be resolved. Drawings are given in Part 2. (D.L.C.)

26448 ANL-6120

Argonne National Lab., Ill.

PRELIMINARY DESIGN AND HAZARDS REPORT; BOILING REACTOR EXPERIMENT V (BORAX V). Feb. 1960. 162p. Contract W-31-109-eng-38. OTS.

The primary objectives of the proposed Borax-V program are to test nuclear superheating concepts and to advance the technology of boiling-water-reactor design by performing experiments which will improve the understanding of factors limiting the stability of boiling reactors at high power densities. The reactor vessel is a cylinder with ellipsoidal heads, made of carbon steel clad internally with stainless steel. Each of the three cores is 24 in. high and has an effective diameter of 39 in. (W.D.M.)

26449 CEND-1000(Vol.II)

Combustion Engineering, Inc. Nuclear Div., Idaho Falls, Idaho.

ABWR QUARTERLY PROGRESS REPORT FOR APRIL 1 TO JUNE 30, 1960. VOLUME II. SL-1 HEALTH PHYSICS AND SAFETY. Aug. 12, 1960. 18p. Contract AT(10-1)-967. (IDO-19017(Vol.II)). OTS.

The health and radiological-safety program in support of Army Reactors (SL-1) operations is summarized. Data and discussions on personnel and area monitoring, radiological test and evaluation, special problem analyses, health physics training, and industrial safety are included. No overexposures to radiation occurred during the period. Radiation levels in the SL-1 plant did not increase. Completion of health and safety training for two SL-1 military crews is reported. (J.R.D.)

26450 GA-1280

General Atomic Div., General Dynamics Corp., San Diego, Calif.

BACKGROUND INFORMATION FOR SELECTION OF BERYLLIA AS MODERATOR FOR THE MARITIME GAS-COOLED REACTOR. Apr. 1, 1960. 29p. Contract AT(04-3)-187. OTS.

Information developed on the Maritime Gas Cooled Reactor (MGCR) project subsequent to the initial moderator evaluation study led to a review of the decision to use graphite as moderator and reflector. A decision was made to substitute BeO for graphite, based on design and cost studies of the two alternative materials. The more current information pertinent to the selection of BeO as moderator

for the MGCR is summarized, and the advantages that will result from its use are discussed. (W.D.M.)

26451 GE-3

Grey (Jerry), Livingston, N. J.

A GASEOUS-CORE NUCLEAR ROCKET UTILIZING HYDRODYNAMIC RETENTION OF FISSIONABLE MATERIAL. PHASE I. PRELIMINARY STUDY. Jerry Grey. Dec. 31, 1958. 96p. For Westinghouse Electric Corp. Flight Propulsion Lab. Dept.

A scheme is described for hydrodynamic containment of a gaseous-core fission reactor applied to rocket propulsion. Approximate analyses are presented for the necessary operating parameters, including the general geometry, internal propellant velocity components, per cent loss of fissionable material, performance characteristics, structural characteristics based on heat transfer, etc. Quantitative conclusions of this rather rough analysis indicate a reasonable degree of practicality for the concept, and performance figures are sufficiently good to warrant further consideration. Topics for further theoretical study and recommended general areas for experimental work in connection with this type of power plant are included. (auth)

26452 GE-4

Grey (Jerry), Livingston, N. J.

PRELIMINARY CONSIDERATIONS ON THE ISOTHERMAL NUCLEAR ROCKET. Jerry Grey. May 31, 1959. 21p. For General Electric Co. Flight Propulsion Lab. Dept.

The performance gains realizable by isothermal heating of the working fluid in a nuclear rocket are explored, and it is concluded that exit Mach numbers of 2 or greater are mandatory. The feasibility of the necessary supersonic-heating process is investigated for both nonreacting real gases and dissociating gases. It is shown by a simple, approximate analysis that isothermal heating of a dissociating gas is possible up to Mach numbers which can produce specific impulses several times greater than those attainable in a "conventional" nuclear rocket having the same maximum allowable core temperature. The optimum chamber pressure is shown to increase rapidly with increasing gas temperatures and with increasing specific heat ratio. A brief examination of the benefits accruing to the heat-transfer process as the result of slip flow indicates that this effect will be important only at pressures too low to be of practical interest. Preliminary design considerations indicate that, if the supersonic heat-transfer requirement could be satisfied, the isothermal nuclear rocket should not be much more difficult to develop than is the "conventional" constant-pressure system. Two major development difficulties are stated and discussed briefly. (auth)

26453 HW-59684

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

SUPERCRITICAL PRESSURE POWER REACTOR. A CONCEPTUAL DESIGN. Mar. 18, 1959. 37p. Contract W-31-109-Eng-52. OTS.

A conceptual design for a power reactor employing supercritical steam as a coolant was completed to provide information concerning the economic and technical feasibility of power plants of this type. The proposed reactor would serve as the heat source for a power-generating system similar to the Philo Number 6 generating unit (Philo Plant of the Ohio Power Company), which utilizes a tandem-compound, double-flow steam turbine operating on 4500 psig and 1150°F steam with two reheats. The base study reactor is a 300 Mw thermal unit, with heavy-water

moderation and light-water coolant. It contains 300 vertical fuel channels arranged in an eight-inch square lattice. The reactor is controlled by adjusting the moderator level. The fuel element is a 10-ft sintered enriched UO_2 core of approximately 3-in. OD. It is pierced with 12 axially oriented, $\frac{3}{8}$ -in. ID coolant channels. The channels are connected in pairs so that the coolant flows downward through six of the channels and back up through the other six. The Inconel-X tubing was assumed to have an average coolant-channel wall thickness of 20 mils, though it will vary depending on channel operating conditions. Construction and operation of such a power-generation system would require the solution of several technical problems, and development work would be required. A summary of some of the problems, which stem primarily from the high operating temperatures and pressures, is included. (auth)

26454 HW-65380

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

YANKEE BAND CUTTING. V. L. Hammond and V. P. Kelly. June 9, 1960. 20p. Contract AT(45-1)-1350. OTS.

Yankee fuel elements may be reduced to subassemblies by either removing the weld at the juncture of the tie band and the rubbing straps or by cutting the bands between the fuel pins. The weld section may be removed by either a high- or low-speed circular saw. The bands between the rods can be severed with a slitting knife. The high-speed abrasive saw was successfully used to remove the weld section. A milling machine was used for the slow speed test. Both methods proved feasible, but the blade must be carefully positioned to avoid cutting into the fuel-element cladding or core. The saber-sawtest for band slitting was not successful. Slitting knives of various blade geometries were used to cut bands successfully. Tests indicate that a Yankee band ($\frac{1}{2}$ -in.-wide by 0.0025-in.-thick 304L stainless steel) can be cut with a force of less than 250 lbs, using a V-blade slitting knife. A knife of this type can be applied using the model 500 General Mills manipulator. The knife system is the simplest of the methods tried and does not appear to damage fuel pins. Three bands can be slit with each pull of the slitting knife; whereas only one weld can be removed per manipulator operation. The tests indicate that the knife should be used for this operation. (auth)

26455 LAMS-2462

Los Alamos Scientific Lab., N. Mex.

QUARTERLY STATUS REPORT ON LAMPRE PROGRAM FOR PERIOD ENDING AUGUST 20, 1960. Samuel Glasstone, comp. and ed. Sept. 1960. 23p. Contract W-7405-eng-36. OTS.

The LAMPRE-I project is summarized in terms of capsule development, sodium system, LCX-III, gas system, and fuel transfer and storage. The 2-Mw Sodium Test Facility was initially placed in operation on Mar. 15, 1960. Since startup, operation has been continuous except for 12 forced shutdowns required for maintenance of auxiliary steam-system equipment and repair of refractory setting in the gas-fired sodium heater. Essentially no maintenance or adjustment has been required on sodium components or the steam generator. The steam-generating unit is illustrated and design heat-transfer criteria and observed heat-transfer data are given. The intermediate sodium heat exchanger, centrifugal sodium pumps, gas-fired sodium heater, sodium flow-control valves, and purification cold trap are discussed briefly. Research and development activities for the LAMPRE Program are reported in the core-development program, core-test facility, mobile-

blanket studies, fuel-alloy development, container-materials development, and fuel processing. (For preceding period see LAMS-2438.) (W.D.M.)

26456 NAA-SR-Memo-4067

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

ADDITIONAL SAFEGUARDS EVALUATION FOR THE U-Mo FUELED CORE OF THE HALLAM NUCLEAR POWER FACILITY. July 7, 1959. 60p. OTS.

Questions posed by the Reactor Hazards Evaluation Branch of the AEC upon review of supplement 1 to the report entitled Preliminary Safeguards Based on U-Mo Fuel for the Hallam Nuclear Power Facility (NAA-SR-3379) are answered in detail. Questions are included on loading-face shield leakage, primary-system confinement cells, NaO prefilter scrubber, fuel-handling incident, removal of dry water pipe lines, and steam generators. (W.D.M.)

26457 NP-9161

European Nuclear Energy Agency, Paris.

O.E.E.C. HIGH TEMPERATURE REACTOR PROJECT (DRAGON) FIRST ANNUAL REPORT, 1959-1960. [Period covered] April 1, 1959-March 31, 1960. July 1960. 294p. OEEC.

Organization for European Economic Co-operation, Paris. \$0.75 Dep.(mc).

The objectives of the Dragon Project are (1) the design, construction, and operation of a 20-Mw reactor experiment at Winfrith with a view to furnishing practical experience with this type of reactor and (2) research and development work in the field of high-temperature gas-cooled reactors. The Project thus far has been principally concerned with finalizing the design of the reactor experiment, elaborating the research and development program, and building up the staff. An over-all view of the state of the project and its methods of functioning as well as the first steps which have been taken towards the fulfillment of its objectives are presented. (W.D.M.)

26458 NP-9236

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

100-MW NUCLEAR POWER PLANT UTILIZING A SODIUM COOLED, GRAPHITE MODERATED REACTOR. Feb. 28, 1958. 103p. (AI-2550). OTS.

The conceptual design of a 100 Mw(e) nuclear power plant is described. The plant utilized a sodium-cooled graphite-moderated reactor with stainless-steel clad, slightly enriched UO_2 fuel. The reactor is provided with three main coolant circuits, and the steam cycle has three stages of regenerative heating. The plant control system allows automatic operation over the range of 20 to 100% load, or manual operation at all loads. The site, reactor, sodium systems, reactor auxiliaries, fuel handling, instrumentation, turbine-generator, buildings, and safety measures are described. Engineering drawings are included. (W.D.M.)

26459 NYO-2937

Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.

STUDY OF REMOTE MILITARY POWER APPLICATIONS. REPORT NO. 1. SUMMARY. Jan. 1960. Revised July 1960. 98p. Contract AT(30-1)-2441. OTS.

An economic evaluation of the construction and operation of 5 to 40 Mw(e) nuclear power plants at several military installations throughout the world is presented. After an evaluation of economic factors involved, 10 sites were chosen for which the cost of nuclear power is most nearly economically competitive with conventional power costs.

The 10 sites include Okinawa, Guam, Thule, Asmara (Eritrea), Inchon, McMurdo Sound (Antarctica), a barge in the Atlantic Ocean, and three sites in the U. S. (NORAD, Super Sage, and Nike-Zeus). A comparison between the capital cost for the nuclear power plant and the conventional power plant is made for all sites. Operating, maintenance, labor, supply, and fuel-oil costs were calculated for an annual cost that could be applied over the assumed 20-year life of the plant. Descriptions and designs of each site are included. (C.J.G.)

26460 NYO-2938

Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.

STUDY OF REMOTE MILITARY POWER APPLICATIONS. REPORT NO. 2. OKINAWA, RYUKYU ISLANDS. Jan. 1960. Revised July 1960. 116p. Contract AT(30-1)-2441. OTS.

A design study and economic evaluation of a 40 Mw(e) nuclear power plant to be located on Okinawa are presented. From a survey of the Okinawa power system, it was concluded that future requirements would best be met by installation of two 22,000 kw (gross) generating units. Studies indicated a 150 Mw(t) direct-cycle natural-circulation boiling-water reactor to be the most suitable for each increment. Studies on land-based, barge-mounted, and platform-mounted installations indicated that the land-based installation would be the most economical. General arrangement and outline drawings, facility descriptions, and construction and operating costs are presented for both nuclear and conventional power plants. (C.J.G.)

26461 NYO-2939

Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.

STUDY OF REMOTE MILITARY POWER APPLICATIONS. REPORT NO. 3. GUAM, MARIANA ISLANDS. Jan. 1960. Revised July 1960. 123p. Contract AT(30-1)-2441. OTS.

A design study and economic evaluation of a 20 Mw(e) nuclear power plant to be located at Guam are presented. A 75 Mw(t) direct-cycle natural-circulation boiling-water reactor was selected for the power plant which is to have a generating capacity of 20,000 kw. General arrangement and outline drawings, facility descriptions, and construction and operation costs are contained for both nuclear and conventional power plants. Studies on installation schemes indicated that a DeLong mobile marine platform would be the most economical. (C.J.G.)

26462 NYO-2940

Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.

STUDY OF REMOTE MILITARY POWER APPLICATIONS. REPORT NO. 4. THULE AIR BASE, GREENLAND. Jan. 1960. Revised July 1960. 150p. Contract AT(30-1)-2441. OTS.

A design study and economic evaluation of a 25 Mw(e) nuclear power plant to be located at Thule are presented. The 25,000 kw power plant, with heating requirements of 150,000,000 Btu/hr, is to be powered by one 130 Mw(t) direct-cycle natural-circulation boiling-water reactor, two 16,500 kw (gross) automatic-extraction turbine-generators, and one 200,000 lb/hr oil-fired stand-by boiler. For comparison purposes, a conventional power plant, consisting of two oil-fired steam boilers and two 16,500 kw (gross) automatic-extraction turbine-generators, was selected. The power plant is to be mounted in a converted C3 in the present berth of a YFP-10, modified to accommodate the larger vessel. General arrangements and outline drawings, facility descriptions, and construction and operation costs

are presented for both conventional and nuclear power plants. (C.J.G.)

26463 NYO-2941

Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.

STUDY OF REMOTE MILITARY POWER APPLICATIONS. REPORT NO. 5. NORAD, NORTH AMERICAN AIR DEFENSE COMMAND OPERATION CENTER, CAMP CARSON, COLORADO. Jan. 1960. Revised July 1960. 88p. Contract AT(30-1)-2441. OTS.

A design-feasibility study is presented on a 6 Mw(e) nuclear power plant for the North American Air Defense Command Operation Center (NORAD) near Camp Carson, Colo. Power requirements for the plant were established as follows: firm power, 4000 kw; peak operating load, 7000 kw; and average operating load, 6000 kw. Two SM-2 pressurized-water reactors and two 6000 kw (gross) turbine generators were selected for the nuclear power plant. In normal operation, cooling water is to be supplied from outside cooling towers; in an emergency, make-up and cooling water is to be supplied from underground reservoirs. Economic aspects of the nuclear power plant are compared to those of a conventional power plant consisting of six 1500 kw diesel engine generators. General arrangement and outline drawings, facility descriptions, and construction and operating costs are presented for both nuclear and conventional plants. (C.J.G.)

26464 NYO-2942

Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.

STUDY OF REMOTE MILITARY POWER APPLICATIONS. REPORT NO. 6. FOURTH U. S. ASA FIELD STATION, ASMARA, ERITREA. Jan. 1960. Revised July 1960. 87p. Contract AT(30-1)-2441. OTS.

Design studies and economic aspects of the installation of a 5 Mw nuclear power station at Asmara, Eritrea are presented. A pressurized-water reactor (SM-2), and one 6000 kw (gross) turbine-generator were selected to meet this power requirement. An economic comparison is made between the nuclear power plant and a conventional plant consisting of six 1250 kw diesel engine generators. General arrangement and outline drawings, facilities description, and construction and operating costs are presented for both nuclear and conventional plants. (C.J.G.)

26465 NYO-2943

Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.

STUDY OF REMOTE MILITARY POWER APPLICATIONS. REPORT NO. 7. SUPER SAGE ROCKY MOUNTAINS AREA. Jan. 1960. Revised July 1960. 94p. Contract AT(30-1)-2441. OTS.

A design study and economic analysis of a 5 Mw(e) nuclear power plant installation at the Super Sage Underground Facility in the Rocky Mountains area are presented. To meet the established power requirements of 3200 kw firm power, an SM-2 pressurized-water reactor with a turbine-generator system capable of generating 6000 kw (gross) during normal operation was chosen. Normally cooling water for the condensers is to be supplied from outside cooling towers; during emergency operation, make-up and cooling water will be supplied from underground reservoirs. Economic aspects of the nuclear plant are compared to those of a conventional plant consisting of six 800-kw diesel engine generators. General arrangement and outline drawings, facility descriptions, and construction and operation costs are contained for both nuclear and conventional plants. (C.J.G.)

26466 NYO-2944

Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.

STUDY OF REMOTE MILITARY POWER APPLICATIONS. REPORT NO. 8. NIKE-ZEUS FAR SITE. Jan. 1960. Revised July 1960. 91p. Contract AT(30-1)-2441. OTS.

A design study and economic analysis of a 10 Mw nuclear power plant installation at Nike-Zeus FAR sites are presented. Two SM-2 pressurized-water reactors and two 6000 kw (gross) turbine-generators were selected for the plant. Economic aspects of the nuclear plant are compared to a conventional plant consisting of six 2500 kw diesel engine generators. General arrangement and outline drawings, facility descriptions, and construction and operation costs are compared for the nuclear plant and the conventional plant. (C.J.G.)

26467 NYO-2945

Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.

STUDY OF REMOTE MILITARY POWER APPLICATIONS. REPORT NO. 9. INCHON, KOREA. Jan. 1960. Revised July 1960. 13p. Contract AT(30-1)-2441. OTS.

A design study and economic analysis of a 10 Mw barge-mounted nuclear power plant installation at Inchon, Korea are presented. A 40 Mw(t) single-loop pressurized-water reactor and a 10,820 kw (gross) turbine generator were selected to meet the power requirements. A cost comparison is made between the nuclear power plant and a conventional plant consisting of five heavy-duty diesel engine generators, rated at 2500 kw each. General arrangement and outline drawings, facility descriptions, and cost analyses are included on both nuclear and conventional plants. (C.J.G.)

26468 NYO-2946

Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.

STUDY OF REMOTE MILITARY POWER APPLICATIONS. REPORT NO. 10. ATLANTIC BARGE. Jan. 1960. Revised July 1960. 130p. Contract AT(30-1)-2441. OTS.

A design study and economic analysis of a barge-mounted nuclear power plant which is to be a mobile emergency-power source for use on the Atlantic Coast are presented. The 20,000 kw (net) plant is to be powered by one 83 Mw(t) two-loop pressurized-water reactor, two 11,500 kw (gross) turbine-generators, and one oil-fired stand-by boiler sized for full-load operation of one turbine-generator. A cost comparison is made between the nuclear plant and a conventional plant consisting of two oil-fired boilers and two turbine-generator units each rated at 11,500 kw (gross). C3-S-A2 vessels from the laid-up merchant fleet were selected for conversion to barge hulls in order to meet the marine-mobility requirement. Facility descriptions, general arrangement drawings, and estimates of construction and operating costs are presented for both nuclear and conventional plants. (C.J.G.)

26469 NYO-2947

Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.

STUDY OF REMOTE MILITARY POWER APPLICATIONS. REPORT NO. 11. U. S. NAVAL AIR FACILITY, McMurdo SOUND, ANTARCTICA. Feb. 1960. Revised July 1960. 86p. Contract AT(30-1)-2441. OTS.

A design study and economic analysis of a 5 Mw(e) nuclear power plant installation at McMurdo Sound, Antarctica, is presented. Power requirements were established at 3000 kw of firm power in 1963 and an increase to 4000 kw of firm power in 1964. Studies indicated that a complex of

three pressurized-water reactors of the PM-1 type, with a net generating capacity of 1500 kw each, would be most suitable to meet the 1963 requirements. An additional PM-1 type reactor would be added in 1964 to obtain the increased power requirement. An economic comparison is made between the nuclear plant and a conventional plant consisting of six 800-kw diesel-engine generators. General arrangement and outline drawings, facility descriptions, and cost comparisons are presented for both nuclear and conventional plants. (C.J.G.)

26470 NYO-2948

Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.

STUDY OF REMOTE MILITARY POWER APPLICATIONS. REPORT NO. 12. EVALUATION AND SELECTION OF APPLICABLE REACTOR CONCEPTS. Jan. 1960. Revised July 1960. 61p. Contract AT(30-1)-2441. OTS.

An evaluation of the reactor concepts under consideration for remote military power plants is presented. The concepts include water-cooled and -moderated reactors, both direct and indirect cycle, organic-cooled and -moderated reactors, heavy-water-cooled and -moderated reactors, gas-cooled reactors, sodium-cooled graphite-moderated reactors, fast reactors, and fluid-fuel reactors. The limitations and advantages, technological status, economics, and future potential of each reactor are reviewed. From the reviews it is concluded that direct-cycle boiling-water and pressurized-water reactors are most suitable for applications requiring power before 1965. (C.J.G.)

26471 NYO-2978

Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.

STUDY OF REMOTE MILITARY POWER APPLICATIONS. HYPOTHETICAL SITE. Feb. 1960. Revised July 1960. Contract AT(30-1)-2441. OTS.

A design study and economic analysis of a 40 Mw(e) nuclear power plant for a hypothetical site located within the general distribution system of a large public utility is presented. Power requirements are to be met by one 135 Mw(t) direct-cycle natural-circulation boiling-water reactor, and one 44,000 kw (gross) turbine-generator. A cost comparison is made between the nuclear plant and a conventional plant consisting of one coal-fired steam boiler and one 44,000 kw (gross) turbine-generator. General arrangement and outline drawings, facility descriptions, and reactor parameters are presented for both nuclear and conventional power plants. (C.J.G.)

26472 NYO-9052

Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.

STUDY OF REMOTE MILITARY POWER APPLICATIONS, BYRD STATION, ANTARCTICA. May 1960. Revised July 1960. 92p. Contract AT(30-1)-2441. OTS.

A design study and economic analysis of an 800 kw (350 kw is electrical load and 450 kw is heating load) nuclear power plant installation at Byrd Station, Antarctica, is presented. Power requirements are to be met by two Army Reactors (PL-2). A cost comparison is made between the nuclear plant and a conventional plant consisting of four 400 kw diesel-engine generators. General arrangement and outline drawings, facility descriptions, and costs of construction and operation are presented for both nuclear and conventional plants. (C.J.G.)

26473 NYO-9053

Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.

STUDY OF REMOTE MILITARY POWER APPLICATIONS.

POLE STATION, ANTARCTICA. May 1960. Revised July 1960. 99p. Contract AT(30-1)-2441. OTS.

A design study and economic analysis of a 500 kw (200 kw is electrical load and 300 kw is heating load) nuclear power plant at Pole Station, Antarctica, are presented. Studies indicated that one Army Reactor (PL-2) plus three 250-kw diesel-engine generators would meet the power requirements. An economic comparison is made between the nuclear plant and a conventional plant consisting of four 250-kw diesel-engine generators. General arrangement and outline drawings, facility descriptions, and cost analyses are presented for both nuclear and conventional plants. (C.J.G.)

26474 NYO-9060

Sanderson and Porter, New York.

FUEL ELEMENT DEVELOPMENT PROGRAM FOR THE PEBBLE BED REACTOR. A Topical Report on SUB-SURFACE COATINGS FOR FUELED GRAPHITE SPHERES. June 30, 1960. 14p. Contract AT(30-1)-2378. OTS.

An exploratory program on subsurface coatings for graphite fuel elements is summarized. A number of coatings with various melting points which could be located beneath the surface of a fueled graphite sphere were investigated. Of the materials with lower melting points, nickel and a special glass compound appeared to form continuous coatings when a hot-pressing technique was employed. Several materials with high melting points, such as Ti, Cr, and MoSi_2 , showed some promise, even though present equipment limitations prevented these specimens from being hot-pressed at the melting point of the coating. (W.L.H.)

26475 NYO-9067

Sanderson and Porter, New York.

THE PEBBLE BED REACTOR PROGRAM. Quarterly Progress Report for January 1, 1960 through March 31, 1960. Changed from OFFICIAL USE ONLY Aug. 16, 1960. 48p. Contract AT(30-1)-2207. OTS.

Fission-product leakage into the PBR coolant stream is the most serious source of contamination. In order to have an indication of the activity level in the coolant primary loop, a master table was prepared based on the total release of all volatile fission products and their daughters which are volatile at or below 2500°F, normalized for 100-Mw(th) output and 100 days operation. The system activity for a 125-Mw(e) PBR is also given. A diffusion separation cell is proposed which offers the possibility of cleaning up the helium coolant irrespective of the level of contamination. A two-group nuclear model and machine program for nuclear analysis of the plant are discussed. Work on fuel-bed development has been limited to critical areas on which further information is needed in order to proceed with the PBR design. These areas are fuel handling, i.e., the problems of continuously refueling under load; ball flow through the bed; a study of gas binding, either caused by or resulting in core hot spots; a determination of core friction factor over a range of Reynolds numbers of interest in design; and the effect of thermal growth of the bed on fuel-element integrity. (See also NYO-9066.) (W.D.M.)

26476 SRO-36

Savannah River Operations Office, AEC.

HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT [FOR] AUGUST 1960. 18p. OTS.

Research and development activities of du Pont, NDC, NMI, and Sargent and Lundy on D_2O power reactors are summarized. Design and construction of the Heavy Water Components Test Reactor are evaluated. The Power Demonstration Reactor Program activities of ECNG-FWCNG

and Carolines-Virginia Nuclear Power Associates are described. (For preceding period see SRO-35.) (W.D.M.)

26477 WAPD-MRP-87

Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh.

PRESSURIZED WATER REACTOR (PWR) PROJECT FOR THE PERIOD JUNE 24, 1960 TO AUGUST 23, 1960. 124p. Contract AT-11-1-GEN-14. OTS.

The development of tube-removal tools, for the purpose of removing tube samples from the 1B, Babcock and Wilcox steam generator, was initiated. A test was conducted on a nuclear power range linear level amplifier to resolve the problem of (1) OPERATE-TEST zero shift and (2) circuit transient. A design modification was prepared. The allowable pressure drop on the air locks and butterfly valves during the performance of DLCS-357 was increased from 0.5 psig/hr to 0.8 psig/hr and 4.0 psig/hr, respectively. This increase will eliminate the excessive maintenance required each time test DLCS-357 is performed. A design modifying the charging-pump relief valve discharge lines was completed. This design eliminated the necessity of freeze plugging the charging-pump suction lines in order to isolate relief valves 08-H15-6 and 08-H15-7. A design adding permanent local-flow indicators for each major component requiring cooling water was completed. This design enables the station operator to regulate the flow of cooling water to equipment. Steady-state and transient power testing of the Babcock and Wilcox and Foster Wheeler Steam Generator was conducted at Shippingport which will provide data for use in PWR Core 2 modifications. Preliminary results from operation of the PWR plant with the purification system bypassed showed some increase in radiation levels in the reactor-vessel head area but no other significant changes in plant radiation levels. Long-lived fission-product levels increased in a predictable manner. The CR-V in-pile test loop was successfully decontaminated from activated corrosion products using the alkaline permanganate ammonium citrate (APAC) process to yield a decontamination factor of 10. The functional requirements for the plant container air cooling system were developed. Reactor Engineering—PWR Core 1: The design of the fuel assembly holders for the M-130 container were completed. The first three calibrations of the core thermocouples were evaluated. Fewer thermocouples showed calibration shifts with time and with temperature cycling in each successive calibration. Reactor pressure drop and core-flow instrumentation were monitored periodically since Seed 2 startup. No significant buildup of pressure drop or decrease in flow were observed. The refueling system description for PWR Core 2 was completed in accordance with established reference method using wet refueling. Preliminary testing of the full-scale carbon-steel model of the PWR Core 2 bottom support was concluded. The initial test was a determination of the load-carrying ability of the weldment alone. Phase I testing of RCH-1 was concluded. After shutdown, components were disassembled and inspected. It was concluded that, with minor exceptions, all components were tested without detrimental effects. Metalurgy of Core Materials: An interim examination of irradiation test plates containing ZrO_2 -34 wt. % UO_2 and ZrO_2 -46 wt. % UO_2 was completed after exposures of 25.3×10^{20} and 18.1×10^{20} fissions/cc, respectively, in the VH-3 Loop of the MTR. These fuel plates showed average increases in thickness of 0.004 in. and 0.0026 in., respectively, which would represent 7.0% and 4.7% increase in fuel swelling, respectively, if the changes are due en-

tirely to the fuel. Density measurements on bulk B_4C irradiated to 1.02×10^{22} B^{10} fissions/cc showed density decreases of about 30%. Means of avoiding exaggerated grain growth during pressure-bonding were developed. A postpressure-bonding heat treatment showed promise of converting Type C bonds to predominantly Type B bonds. Thermal-expansion measurements showed that the expansivities of ZrO_2 -25 wt. % UO_2 and ZrO_2 -34 wt. % fuel compositions were about 10% greater than that of pure UO_2 . A 3-day corrosion test in 750°F steam on platelets of ZrO_2 -25 wt. % UO_2 and ZrO_2 -34 wt. % UO_2 showed the same negligible weight changes as were observed for a three-day test in 650°F water. Diffusion anneal data for Xe^{133} in ZrO_2 -25 wt. % UO_2 indicated that diffusion coefficients are about two orders of magnitude greater in ZrO_2 -25 wt. % UO_2 than in UO_2 . Reactor Physics: The PWR Core 1 Seed 2 three-dimensional life-history study, in which control-rod positions observed at Shippingport are used for each calculation, was carried through 1600 EFPH of Seed 2 lifetime. The second of the UO_2 fuel rods removed from the PWR Core 1 blanket during Seed 2 refueling was analyzed for uranium and plutonium isotopic content. The effect on the end of life axial powershape in the PWR Core 2 seed of the nonuniform distribution of moderator density existing during power operation was studied. The temperature defect for PWR Core 2 was calculated using two different representations of the fast few-group constants and two control-rod configurations. Investigations were performed to identify the preferred method of obtaining U^{238} L-factors for calculating fast-neutron few-group constants using the MUFT code. Two calculational models were used to compute the neutron activations in an octant of PWR Core 2 mockup, and the seed-blanket power distributions were inferred. The reactivity loss for a five-cluster PWR Core 2 slab assembly was computed for a temperature change from 68 to 472°F in preparation for the UO_2 mockup experiments in the HTTF. Recent tests performed on PWR Core 1 Seed 2 indicated that the inferred temperature coefficient of reactivity at power has decreased to a value of $-1.1 \times 10^{-4}/^\circ\text{F}$. (For preceding period see WAPD-MRF-86.) (auth)

26478

THE RELATIVE ADVANTAGES OF ADVANCED GAS COOLED REACTORS AND MAGNOX TYPES. P. D. Murphy (Nuclear Power Group, London). Brit. Power Eng. 1, No. 4, 61-4(1960) Sept.

The basic differences in these types are outlined according to the intent of the Advanced Gas Cooled Reactor (AGR). The aims of the AGR are to increase fuel rating, i.e., instantaneous heat production per unit weight of fuel, by about 4:1; increase the outlet gas temperature by 200°C; increase fuel irradiation, i.e., total heat abstracted per unit weight of fuel, by ~4:1. The over-all physical effect of the changes necessary to accomplish this is that the reactor for a given heat output will be much smaller in size and the station efficiency will be increased by ~10%. For purposes of comparing the costs of the two systems, the power generation (d/kwh) costs are assumed to be composed of capital cost; fuel cost; and operation and maintenance. The factors that govern the generating costs are station design output, specific capital cost, amortization period and basic interest rate, load factor, fuel price, fuel irradiation, and over-all station efficiency. The conclusion as to which system holds the ultimate advantage is not an easy one to draw at this stage. It is the work of the immediate future to reveal the true value of this by the resolution of these uncertainties. (B.O.G.)

26479

THE OUTLOOK FOR COMMERCIAL MARITIME NUCLEAR PROPULSION. G. A. M. Wilson. Brit. Power Eng. 1, No. 4, 65-8(1960) Sept.

Power plant design, installation, and safety and waste disposal are considered in an evaluation of marine nuclear propulsion. Applications of pressurized-water, boiling-water, organic-moderated, supercritical heavy-water, and high-temperature gas-cooled reactor types are discussed. (D.E.B.)

26480

POWER REACTORS. POWER PLANTS OF THE ENRICHED URANIUM, PRESSURIZED WATER TYPE. Pierre Bourgade. Énergie nucléaire 2, 231-8(1960) July-Aug. (In French)

The pressurized water reactor, which has been studied especially in the United States, is described. The components of the reactor are described, and their essential characteristics are emphasized. The factors affecting the construction and exploitation of this type of reactor are then examined and discussed. (tr-auth)

26481

NUCLEAR ENERGY IN THE FUTURE ENERGY BALANCE. [PART] II. Pierre Sevette. Inds. atomiques 4, No. 1-2, 89-112(1960). (In French)

In this second part of the role of nuclear power for energy production, the nuclear power stations under construction or in the planning stage are considered. A tabulation is presented of the characteristics of nuclear power plants in operation, under construction, or being planned. The long-term nuclear programs for several countries are presented, and the resources in fissionable materials are considered. Energy production by fusion processes and direct production of electrical energy are briefly discussed. The economic conditions for the integration of nuclear energy into the electrical energy production system are examined. (J.S.R.)

26482

ACTIVATION CALCULATIONS FOR THE PRIMARY LOOP OF A PRESSURIZED WATER REACTOR INSTALLATION. A. Rau and G. Schumann (Wissenschaftlich-Technische Büro für Reaktorbau, Berlin-Pankow). Kernenergie 3, 707-16(1960) Aug. (In German)

The activation in the primary loop of a pressurized-water reactor such as the 60-Mw Shippingport Power Plant was calculated. The results are given for both the stationary and the unstationary case. (T.R.H.)

26483

EVOLUTION OF NUCLEAR POWER PLANT DESIGN. Christopher Hinton. Nature 187, 1064-70(1960) Sept. 24.

Advances in technology that reduce the cost of power generation by conventional and nuclear methods are discussed. Nuclear power from the plants that are now being ordered will cost about 25% more than from the best conventional plants built concurrently and operated under similar load conditions. Methods by which higher temperatures can be achieved in the heat cycle are outlined. The top temperature achieved is determined by the bulk outlet temperature of the coolant gas and this is determined by the temperature tolerable in the hottest fuel element. The use of beryllium or stainless steel as canning materials will increase the temperature that can be achieved, but it will also increase the cost. This can be compensated by using uranium in ceramic form as fuel. The Atomic Energy Authority designed the advanced graphite reactor being built at Windscale as a prototype for the next logical step

forward in technology. The cost forecast for conventional and nuclear power indicates that costs should break even between 1966 and 1970. The high-temperature gas-cooled reactor that is at present in the project stage at Winfrith Heath is an attempt to meet the problem of using graphite at high temperatures by using graphite as a canning material; this can be replaced as the fuel elements are changed. (M.C.G.)

26484

GAS VALVES FOR NUCLEAR POWER STATIONS. C. D. Blakeborough (J. Blakeborough and Sons, Ltd., [Brighouse, Eng.]). Nuclear Power 5, No. 53, 96-9(1960) Sept.

A review is presented for gas valves for nuclear power stations, both gas-cooled and liquid-cooled. Such valves are generally of cast construction and hence more susceptible to leakage than fabricated valves. In many valves, gaskets are used to reduce casting weight. The most troublesome source of leakage is the spindle, but graphited asbestos packing can give small leakages up to 300°C, above which this packing fails, especially when the gland is subjected to temperature cycling. The alternative to a packed gland, bellows, has several limitations, e.g., it cannot be stretched too far or transmit rotary motion. Lubrication problems in dry noncorrosive gases like CO₂ are discussed; in such gases, no lubrication can occur and scuffing may ensue, resulting in seizure and leakage. Different valves used to isolate the reactor shell from the main heat exchangers are discussed. At Calder Hall and Chapelcross, wedge gate valves of single cast construction were successfully used, but at Hunterston fabricated gate valves are being installed. Butterfly valves, however, offer the advantage of rapid closure and have been used in Calder Hall type stations in England, Italy, and Japan. The problem of supplying valves to station sites in "clean condition" and how it is met are discussed. For ship propulsion units employing pressurized-water or organic-moderated reactors, valves will be similar to those now being made for high-pressure feed water service. (D.L.C.)

26485

STEAM CYCLES FOR POWER REACTORS. [PART] I. W. J. Thomas (Kennedy and Donkin, [London]). Nuclear Power 5, No. 53, 110-12(1960) Sept.

Steam cycles for power reactors are considered, and ways of increasing their efficiency are studied with reference to the Rankine cycle. The effect of blade-system inefficiency on the entropy is studied. The thermal performance of steam cycles can be increased by the following means: increase of stop valve pressure; increase of stop valve temperature; provision of reheat; increase in final feed-water temperature; and increase in vacuum. The possible extra capital costs resulting from each of the above means are given. Next, CO₂-cooled British reactor cycles are considered, and performance data are presented for the Hunterston and Dungeness nuclear stations. The dual-pressure steam cycle is preferred over other cycles from the viewpoint of present-day costs. (D.L.C.)

26486

PREDICTING FUEL ELEMENT LIFETIME. J. K. Davidson and L. H. Devlin (Allis-Chalmers Mfg. Co., Milwaukee). Nuclear Power 5, No. 53, 118-21(1960) Sept.

The probable number of fuel-element failures in the operation of the Experimental Gas-Cooled Reactor (EGCR) is estimated from calculated fuel-element temperatures, power, and exposures. The fuel-element assembly, designed for a lifetime of 10⁴ Mwd/ton of uranium, is divided into six zones containing channels of nearly equal thermal power and into vertical sections for calculation purposes.

The principal cause of failures is excessive cladding temperatures combined with internal gas pressure from fission product build-up in the voids; fuel-element defects were not considered as causes of failure. For the cladding, allowable stresses were determined from creep and stress-rupture data for type 304 stainless steel in air. A normal temperature distribution was assumed. It was found that under EGCR design conditions five fuel assemblies in a core loading of 1296 assemblies will contain a failure before the burn-up exposure of 10^4 Mwd/ton of uranium is reached. (D.L.C.)

26487

COMPETITIVE NUCLEAR POWER FOR CANADA. W. B. Lewis (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucleonics 18, No. 10, 54-9(1960) Oct.

A comparison is given of the expected cost of power in Ontario from nuclear and conventional plants. Coal at \$8/ton contributes about 3 mills/kwh to the cost of conventional power. The estimate for nuclear fuel for a 200 Mw(e) reactor of the CANDU type is 1.1 mills/kwh, falling almost immediately to 0.9 mill/kwh. When the fuel is standardized so that automatic fabrication becomes possible, the fueling costs could perhaps be brought to 0.6 mill/kwh even during the lifetime of the first CANDU reactor. With the estimated total capital cost of \$137/kw(e) for the large conventional plant the total capital cost for the nuclear plant can be \$347/kw(e). These expectations presume no advances in technology such as the production of new alloys, or operating at higher fuel ratings than at present. The bases for the cost predictions for the nuclear and conventional power plants are discussed. (B.O.G.)

26488

CANDU FUELING COSTS—BREAKING THE 1-MILL/KWH BARRIER. A. J. Mooradian and J. A. L. Robertson (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucleonics 18, No. 10, 60-5; 122(1960) Oct.

A fueling cost of 1 mill/kwh, or less, should be achieved for the second CANDU core. Reductions are anticipated in three areas of fuel production: finished UO_2 pellets, finished Zircaloy components, and assembly and testing of fuel bundles. The fuel bundles for the CANDU will be similar to those of Nuclear Power Demonstration (NPD) and will thereby profit from NPD fabrication and operating experience. NPD fuel fabrication and CANDU fuel development are discussed and compared. The essential difference between the 19-element fuel in NPD and that in CANDU is the maximum rating which is 3.9 kw/cm length and 8.7 kw/cm length, respectively. (B.O.G.)

26489

ON-POWER REFUELING. J. S. Foster (Atomic Energy of Canada Ltd., Toronto), W. M. Brown, and H. E. Tilbe. Nucleonics 18, No. 10, 66-8(1960) Oct.

Refueling at power leads to higher, more uniform burn-up and makes a reactor available more of the time. A discussion is presented on the scheme and machines being developed for Nuclear Power Demonstration (NPD) and CANDU. This scheme reduces the number of start-ups and shutdowns with their attendant difficulties and provides a means for eliminating faulty fuel as soon as it is identified, reducing contamination of the reactor system and permitting some relaxation of fuel quality requirements. A combination of many advantages dictated the adoption of power refueling, none of which were of sufficient importance in itself to compel adoption. Development of the described loading machines for NPD and CANDU costs about \$2 million, but not all of this cost can be charged to the on-power feature. (B.O.G.)

26490

ORGANIC-COOLED DEUTERIUM-MODERATED REACTORS. Ian MacKay (Canadian General Electric Co., Ltd., Peterborough, Ont.). Nucleonics 18, No. 10, 78-80 (1960) Oct.

The Organic-cooled Deuterium-moderated Reactor (OCDR) uses heavy water as moderator, but extracts heat from the fuel channels with an organic coolant. It combines the low fueling costs resulting from D_2O moderation and "once through" natural-uranium fuel with the low capital costs expected from the use of organic coolants. Capital costs, and to some extent maintenance costs, are reduced through such properties of organic coolants as low vapor pressure, good radiation and thermal stability, noncorrosiveness at high temperatures, low induced radioactivity, and relatively low price. Such properties eliminate the need for high-pressure construction, extend the use of carbon steel and aluminum, permit the use of industrial type pumps and fittings, and make possible high bulk-coolant outlet temperatures. (B.O.G.)

26491

NUCLEAR POWER—HOW, WHEN, AND IF. Wade Dickinson (Bechtel Corp., San Francisco). Texas Eng. Expt. Sta. Misc. Publ. E 72-60 15-18(1960) Apr.

The state of commercial nuclear power is examined system by system. The cost of power produced by nuclear systems is compared with the cost of power produced by conventional systems. (W.L.H.)

26492

REACTORS FOR PROPULSION OF MANNED AIRCRAFT AND MISSILES. J. E. Bicknell (U. S. Atomic Energy Commission, Washington, D. C.). Texas Eng. Expt. Sta. Misc. Publ. E 72-60 19-28(1960) Apr.

The four programs of the Atomic Energy Commission concerned with aerospace application of nuclear energy are discussed. Three are concerned with reactors for propulsion and one is concerned with the application of nuclear energy to generate auxiliary electrical power. Two aeronautically oriented propulsion reactor programs are the manned nuclear-powered aircraft and the nuclear-powered ram-jet (Project PLUTO). Two space-oriented programs are the nuclear-powered rocket program (Project ROVER) and the nuclear auxiliary power program (Project SNAP). A résumé of radiological safety considerations inherently associated with aerospace applications of nuclear energy is included. (W.L.H.)

26493

NUCLEAR REACTOR CONTROL. (to Commissariat à l'Énergie Atomique). British Patent 839,940. June 29, 1960.

A reactor control system is proposed for nuclear power plants whose power load is variable, e.g., reactor-propelled craft and vehicles. The system is based on cyclically varying the multiplication factor, determining the corresponding variations in the neutron density, and operating the reactor controls as a servo-loop in response to the time lag between the factor and density variations. In this system, there are two main channels, one delivering a cyclic signal from the multiplication factor variations (modulating) and the other delivering the corresponding signal from the neutron density variations (detecting); the signals are applied to a phase detector. The phase detector output is used with an automatic program device to operate the control rods by means of a servo motor. This system can control a reactor in the subcritical, critical, and supercritical ranges. Block diagrams of the system are given. (D.L.C.)

Production Reactors

26494

METHOD AND APPARATUS FOR IMPROVING PERFORMANCE OF A FAST REACTOR. (to U. S. Atomic Energy Commission). British Patent 843,636. Aug. 4, 1960.

A fertile-fissionable material arrangement is given for fast-breeder reactors in which the fissionable material forms a hollow core and the fertile material forms two blankets surrounding the core from both outside and inside. The advantages of such an arrangement are that all the neutrons are utilized, the neutron flux at the center is flattened out giving better performance, and the operating temperatures in the center are lowered. The fissionable material is a plutonium-uranium alloy, and the fertile material is depleted uranium. Details are given on the reactor and its operation. (D.L.C.)

26495

IMPROVED FUEL-BREEDER ELEMENT FOR A NUCLEAR REACTOR. (to U. S. Atomic Energy Commission). British Patent 847,847. Sept. 14, 1960.

A unique fuel-element design is proposed for breeder reactors in which the fertile and fissionable materials are separated, the fissionable material being in the nonaqueous fluid phase. The fertile material is fabricated as the core of a fuel element with the fissionable material dissolved or suspended in a molten inorganic medium, e.g., bismuth or bismuth-tin for uranium or a fused fluoride mixture for UF_4 , surrounding the core and in contact with the container (stainless steel or zirconium). Because the solubility of uranium in the above molten solvents is low, it should be enriched >90% U^{235} or U^{233} . The advantages of this fuel-element design are ease of fabrication, ease of reprocessing for fertile material recovery, high burn-up, resistance to radiation damage or growth, and improved heat transfer owing to the power level not being limited by the center temperature. The fuel element is particularly suitable for use in sodium-cooled graphite-moderated thermal reactors. (D.L.C.)

26496

REACTOR. (to United Kingdom Atomic Energy Authority). British Patent 847,903. Sept. 14, 1960.

U^{233} may be produced by irradiating Th^{232} bodies with neutrons of energy <1 Mev from a reactor (more completely described by Patent No. 817,751) in which the Th^{232} bodies are contained in external channels and the fissionable material is in inner channels. The Th^{232} bodies are canned thorium carbonate pellets prepared by heating thorium carbonate to constant weight at 200°C and compressing it into pellets with a density ≥ 2.6 g/cm³. The irradiation is stopped before the ratio U^{233}/Th^{232} reaches 1/100 so that fission products are kept to a minimum and the U^{233} can be isolated by ordinary chemical means. (D.L.C.)

Research Reactors

26497 AD-235105

Lockheed Nuclear Products, Marietta, Ga.
ANALYSIS OF FOIL DATA FOR SYSTEMS TESTS AT THE RADIATION EFFECTS FACILITY. Period [covered]: April 1, 1959–September 30, 1959. R. M. Thornton. Jan. 1960. 17p. Contract AF33(600)-38947. (NR-76).

The derivations of the equations used to convert foil counting rates to fluxes are given. The foils are used to determine fluxes at various points on the systems and are of three general types: thermal-flux detectors, resonance-

flux detectors, and fast-flux detectors. Equations are included for all three types of foils, and the effect of the complicated reactor power cycle is taken into account in these equations. A brief discussion of some of the problems encountered in the use of these methods at the Radiation Effects Facility is included. (auth)

26498 ANL-6194

Argonne National Lab., Ill.
FAST FUEL TEST REACTOR—FFTR CONCEPTUAL DESIGN STUDY. R. Brubaker, H. H. Hummel, A. McCarthy, A. Smaardyk, and J. H. Kittel. Aug. 1960. 101p. Contract W-31-109-eng-38. OTS.

The Fast Fuel Test Reactor (FFTR) is a nuclear facility for the purpose of irradiating samples of fuels and structural components for use in fast reactors. The core consists of a plate type element in a square configuration. Beryllium metal between the fuel elements is used to obtain a neutron energy spectrum in the hard intermediate region. Cooling of the core and test specimens is accomplished by means of liquid sodium. The design concept was carried through in sufficient degree in the following areas of preliminary concern: number and size of irradiation facilities, sample power requirements, plant layout to evaluate site requirements, plant and nuclear design parameters to evaluate essential equipment requirements, plant-capital-cost estimate, annual-operating-cost estimate, and estimate of construction time schedule. (W.D.M.)

26499 BNL-600

Brookhaven National Lab., Upton, N. Y.
DESCRIPTION OF FACILITIES AND MECHANICAL COMPONENTS, MEDICAL RESEARCH REACTOR (MRR). Jules B. Godel. Feb. 1960. 71p. OTS.

A description of the Medical Research Reactor (MRR), a heterogeneous tank type reactor designed exclusively for medical and biological studies, is given. It is housed in a 60-ft-diameter cylindrical gas-tight steel building. The core contains a clean critical mass of 2.24 kg U^{235} in 17 fuel elements of standard curved-plate design. The MRR operates at power levels up to 3 Mw and is cooled by the forced circulation of water. The control-rod system consists of three B_4C filled safety rods and one stainless-steel regulating rod which fit between fuel elements. Nuclear instrumentation includes a safety system which will set back or scram the reactor if two out of three identical channels are tripped. Heat generated in the dry graphite reflector surrounding the reactor vessel is removed by the flow of filtered air. Experimental facilities include two shielded rooms equipped with special treatment ports and vertical 20-ton shutters. The measured radiation at the treatment port for 1-Mw power is 2.03×10^{10} neutrons/cm²-sec (thermal) with an associated gamma flux of 37 r/min. A broad beam experimental area located at the end of a thermal column is used for whole-body irradiation investigations. In addition to these facilities, three 4-in. horizontal thimbles, two tangential and one radial to the core, are contained in the MRR. (auth)

26500 CF-60-3-33

Oak Ridge National Lab., Tenn.
HIGH FLUX ISOTOPE REACTOR—A GENERAL DESCRIPTION. T. E. Cole. Mar. 1960. 66p. Contract W-7405-eng-26. OTS.

The High Flux Isotope Reactor (HFIR) is being planned for construction at Oak Ridge National Laboratory as a supporting facility in the program of investigation of the properties of the transplutonium elements. The reactor will be a flux-trap reactor consisting of a beryllium-reflected, light-water-cooled annular fuel region surround-

ing a light-water island. An irradiation sample of 200 to 300 g of Pu^{242} will be placed in the island where a thermal-neutron flux of approximately 3×10^{15} n/cm²/sec can be achieved on the average during an irradiation period of about 1 year. It is estimated that more than 100 mg of Cf^{252} will be produced by such an irradiation. In addition to the central irradiation facility for heavy-element production, the HFIR will have eight hydraulic rabbit tubes located in the beryllium reflector and four beam holes for basic research. Preliminary design of the reactor was based on the results of a parametric study of the dimensions of the island and fuel region, heat-removal rates, and fuel loading on the achievable thermal-neutron fluxes in the island and reflector. A research and development program including critical experiments, heat transfer, corrosion, and fuel-element studies has been in progress to verify the important parameters used in the design. The present design results in an average power density of 2.2 Mw/l in the active core and requires a maximum heat-transfer rate from fuel-plate surfaces of 1.5×10^6 Btu/ft²/hr. This heat-transfer rate is achieved by flowing H_2O , at an inlet temperature of 120°F, and a pressure of 600 to 900 psig, through the 0.05-in. coolant channels at a velocity of 40 fps. A preliminary analysis of the hazards brought on by a reactor core meltdown shows that a controlled-leakage, filter-scrubber, stack release system of the ORR type will limit the consequences of such an accident to an acceptable degree. Construction is scheduled to start in early 1961 with operation at power scheduled for Jan. 1964. The estimated cost of the facility including engineering is \$12,000,000. (auth)

26501 CF-60-9-2

Oak Ridge National Lab., Tenn.

ORR OPERATIONS FOR PERIOD APRIL 1959 TO APRIL 1960. J. A. Cox. Sept. 30, 1960. 144p. OTS.

The second year of Oak Ridge Research Reactor (ORR) operation was marked by steady progress toward more stable operation of the reactor. Control problems were reduced sufficiently to allow an operating time, during the last quarter, of greater than 81%. The reactor has been operated effectively at 20 Mw, with the exception of the period of July 18 to Oct. 4 when operation was at 16 Mw. Design changes are being made to allow operation at 30 Mw to begin during the summer of 1960. Sections from the four quarterly reports of the Operations Division are compiled. (W.D.M.)

26502 CREL-923

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

THE DYNAMIC BEHAVIOUR OF THE NRX CONTROL SYSTEM. C. G. Lennox and A. Pearson. June 1960. 107p. (AECL-1050). AECL.

The dynamic behavior of the control system of the NRX Reactor is discussed relative to reactor response, reactivity-control system, dynamic and static behavior and operation, control-valve dynamic behavior and operation, logarithmic-rate control (channel gain, small-signal analysis, noise suppression, loop stability, and transient response), linear-rate control, and steady-power control. (C.J.G.)

26503 CEA-tr-X-189

TRAVAUX RELATIFS AU PROJET DU DEUXIÈME RÉACTEUR EXPERIMENTAL POLONAIS. (Work Related to The Second Polish Experimental Reactor Project). Krystyna Kowalska. Translated into French from *Nukleonika* 3, No. 2, 180-4(1958). 9p.

The organization of work for the second experimental

Polish reactor project is presented. The choice of the type of reactor was made, and the characteristics of certain variables were calculated from the thermal and nuclear point of view. The method of presentation of these results and the manner of their use are discussed. The status of work on the project and the future program are given. (tr-auth)

26504

AXIAL DISTRIBUTION OF FAST NEUTRONS IN THE THERMAL COLUMN OF THE TEST REACTOR OF THE INSTITUTE OF ATOMIC PHYSICS, RUMANIAN ACADEMY OF SCIENCES. L. Cojocaru and V. Iosif. *Acad. rep. populare Romîne, Inst. fiz., atomică și Inst. fiz. Studii cercetări fiz.* 11, No. 1, 236-40(1960). (In Rumanian)

The axial flux distribution of the thermal column of the reactor, which has a circular cross section with a diameter of about 90 cm and a length of 300 cm, was investigated by means of aluminum fast-neutron detectors placed at various distances from the core. The detectors had an energy of $E = 2.1$ Mev for the (n,p) reaction. A cadmium cover was used to eliminate the parasitic activity of the thermal neutrons. The resulting β activity was determined by G-M counters. It was found that the flux varied from $(6.0 \pm 1.2) \times 10^{11}$ at 5 cm to $(7.3 \pm 1.4) \times 10^8$ at 77.8 cm. According to the data, the axial distribution of the fast-neutron flux decreases at a faster rate in the thermal column of the reactor moderated with ordinary water than in the corresponding facility of a graphite-moderated reactor. (TTT)

26505

DETERMINATION OF THE FAST NEUTRON SPECTRUM OF THE TEST REACTOR OF THE INSTITUTE OF ATOMIC PHYSICS, RUMANIAN ACADEMY OF SCIENCES.

V. Nahorniak. *Acad. rep. populare Romîne, Inst. fiz., atomică și Inst. fiz. Studii cercetări fiz.* 11, No. 1, 250-5 (1960). (In Rumanian)

The fast-neutron spectrum was determined using cadmium-covered nuclear plates, placed parallel with the path of the neutron beam, as detectors. For each of the two configurations used the trajectories of the recoil protons resulting from collisions between the incident neutrons and the H of the emulsion were measured, taking into consideration only the protons the direction of which formed an angle smaller than 10° with the direction of the incident neutrons, in which case their energies are equal within an error of 3%. It was found that the experimental points lie near the curve that represents the fast neutrons from fission. Complete agreement cannot be expected because after leaving the uranium rod the neutron must pass through 2 cm of water. When the neutron had to pass through a 5-cm-thick water layer, the lack of agreement was even more noticeable. On the other hand, the data agree well with results obtained with the similar BSR. (TTT)

26506

GAMMA RADIATIONS EMITTED BY HEAVY WATER.

A. Blanc, C. Julliot, and A. Lansart. *Bull. inform. sci. et tech. (Paris)* No. 40, 61-73(1960) May. (In French)

A detailed study was made of the γ radiations emitted by heavy water after impurity activation in reactors. Measurements were made on the EL-2 and EL-3 reactors. F^{19} , the result of the reaction between accelerated deuterons and natural oxygen, was detected. The activity found was in good agreement with that calculated. The nature and the activity of the fission products found in the water after a can failure were determined. (tr-auth)

26507

CHARACTERISTICS OF SWIMMING POOL REACTORS.

SURVEY OF FRENCH ACHIEVEMENTS. Marcel Trioulaire (Commissariat à l'Énergie Atomique, [Paris]). Inds. atomiques 4, No. 1-2, 57-70(1960). (In French)

Two swimming-pool reactors of 1000 kw each were started up in France during the last year: the Melusine and the Triton. These installations are described concisely as a function of the triple role of water in this type of reactor, as neutron moderator, coolant fluid, and shielding against radiations. (tr-auth)

26500

ENGINEERING TEST NUCLEAR REACTOR. (to U. S. Atomic Energy Commission). British Patent 847,843. Sept. 14, 1960.

The design of the Engineering Test Reactor, a research reactor having high thermal and fast neutron flux facilities, is given. It is water-cooled and -moderated and uses uranium enriched to 90% U^{235} , although other fuels containing U^{233} or Pu^{239} may be used. The core comprises a multicellular array of fuel assemblies arranged in the form of a cross with a large central hole and several corner holes as irradiation facilities. Neutron fluxes of 5 to 6.7×10^{14} (thermal) and 1.7×10^{15} (epithermal) neutrons/cm²/sec are obtainable in the central hole with 2.3 to 3×10^{14} (thermal) and 9×10^{14} (epithermal) neutrons/cm²/sec fluxes in the corner holes. (D.L.C.)

WASTE DISPOSAL AND PROCESSING

26509 DP-478

Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.

UNDERGROUND STORAGE OF LOW LEVEL RADIOACTIVE WASTES AT THE SAVANNAH RIVER PLANT. ENGINEERING CONSIDERATIONS. A. N. Daniel, June 1960. 60p. Contract AT(07-2)-1. OTS.

The engineering considerations are given on which the design and construction of tanks for the storage of low-level radioactive waste solutions were based. The tanks have a nominal capacity of 1,300,000 gal each. While conforming to the principle of total confinement, these tanks were built at a considerably lower cost than the tanks designed for storing high-level radioactive wastes. This saving was brought about by the elimination of a number of features such as cooling coils and the annular space and secondary saucer container around the tank. (auth)

26510 HW-65209

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

FIXATION OF RADIOACTIVE RESIDUES. RESEARCH AND DEVELOPMENT ACTIVITIES QUARTERLY PROGRESS REPORT [FOR] JANUARY-MARCH 1960. D. W. Pearce, ed. Apr. 15, 1960. 31p. Contract AT(45-1)-1350. OTS.

Waste calcination studies in the fluid-bed reactor, using $Al(NO_3)_3$ feed, were completed. Studies using simulated Purex acid wastes were initiated. Testing of nozzle design variations to overcome the nozzle lump problem is underway. The break-in period for the fluid-bed calciner was completed with the last run, using simulated ICPP waste feed solution. Sixteen short tests were then completed, using simulated Purex waste solutions. Laboratory-scale studies continued on the batch calcination of simulated Purex high-activity-level wastes. The majority of the studies were made in an unagitated 3-in.-diameter 7-in.-high gas-heated stainless steel pot. The relative concentra-

tions of the major cations in the feed were varied to determine possible effects on the calcine properties. The possibility of improving thermal conductivity of a granular material by incorporating it into a continuous matrix of metal or other good thermal conductor was investigated. Investigation of radiant-heat spray calcination process was continued. Work was continued on decontaminating wastes by percolating them through beds of selected minerals. Most of the work involved study of the mineral clinoptilolite as a decontamination bed. Scouting studies to discover potentially useful mineral reactions for decontaminating waste streams are reported. Effective removal of Cs^{137} from an actual condensate waste by adsorption on 5-g 22-cm laboratory columns of clinoptilolite was demonstrated. Initial investigations of the effect of γ irradiation on clinoptilolite are reported. Scouting studies were begun to evaluate the use of clinoptilolite beds for decontamination and solid fixation of high-level wastes. (For preceding period see HW-63949.) (W.L.H.)

26511 ORNL-2984

Oak Ridge National Lab., Tenn.

WASTE DISPOSAL IN SALT. I. THE HNO_3 -NaCl REACTION. Hisashi Kubota and Tsuneo Tamura. Oct. 5, 1960. 17p. Contract W-7405-eng-26. OTS.

The chemical reaction between nitric acid and sodium chloride was investigated in order to provide preliminary information for subsequent studies on the interaction between simulated Purex waste solution and salt. The reaction is characterized by the production of chlorine and nitrosyl chloride and can be considered to be the same as the aqua regia reaction. Within the limits of the conditions imposed by the projected field studies, the acid concentration and temperature are the two parameters which control the extent of the interaction. (auth)

26512 ORNL-2993(p.108-11)

Oak Ridge National Lab., Tenn.

GAS COOLED REACTOR COOLANT AND EQUIPMENT DECONTAMINATION.

Experimental studies on fixed-bed oxidation of hydrogen in helium carrier gas were carried out in a 2-in.-diameter CuO bed to provide design data for the EGCR gas-purification system. The results of these tests were correlated, and a design equation was obtained which specifies the required bed volume. A noncorrosive procedure was developed for decontaminating the EGCR charge and service machines which consists in spraying with hot, nonfoaming detergent solution to remove water-soluble fission products and flush off particles. A peroxide-sodium oxalate solution is then used to dissolve residual UO_2 and remove adsorbed fission products. (auth)

26513

GEOLOGY AND HYDROLOGY IN THE DISPOSAL OF RADIOACTIVE WASTES. Boone M. Bowen, Jr., J. M. Selby, and James Hubert Edgerton. Bull. Georgia Acad. Sci. 17, 145-52(1959) Sept. (GeoScience abstr. 2, No. 8, (1960) Aug.).

The problems of radioactive waste disposal and the talents needed to solve them are varied. Solid, liquid, and gaseous wastes must be handled in different ways. Many of the methods are in the realm of the earth sciences. Ground disposal of solid as well as low- and intermediate-level liquid wastes is an efficient, safe, and economical method when effected under carefully controlled conditions. Geological and hydrological parameters are of utmost importance in this method. Other means of radioactive waste disposal of concern to geologists are being investigated, and more research and development need to be done on these projects. (auth)

26514

THE EFFECT ON THE RESIDUAL NATURAL GAS IF RADIOACTIVE WASTE MATERIALS WERE TO BE STORED IN A SUITABLE ABANDONED GAS RESERVOIR.

George W. Crawford (Univ. of Texas, Austin). Texas Eng. Expt. Sta. Misc. Publ. E 72-60 12-14(1960) Apr.

Considerable natural gas remains in a gas reservoir after the reservoir pressure drops below pipe line pressure and the gas reservoir is abandoned. This study was made to determine the changes in the natural gas which would be caused by the γ irradiation if radioactive waste materials were to be stored in the reservoir. A series of

investigations was carried out involving irradiation of pure hydrocarbons, mixtures of pure hydrocarbons, and natural gas. Samples of natural gas were irradiated in bulk and in a sand core to determine the effect of environment. The gas phase of the irradiated natural gas is richer in hydrogen, ethane, propane, and hexane-plus hydrocarbons. Approximately one-fourth of the methane molecules that decompose from hydrogen gas and a liquid made up of molecules having a structure of C_nH_{2n} . The gas pressure will be increased both by the decomposition of molecules and by the resulting rise in the temperature of the reservoir from absorption of the radiant energy. (auth)

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